U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 35.
D. E. SALMON, D. V. M., Chief of Bureau.

ELEVEN MISCELLANEOUS PAPERS

ON

ANIMAL PARASITES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 35.

D. E. SALMON, D. V. M., Chief of Bureau.

ELEVEN MISCELLANEOUS PAPERS

ON

ANIMAL PARASITES.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1902.

ORGANIZATION OF THE BUREAU OF ANIMAL INDUSTRY.

Chief: D. E. Salmon, D. V. M.
Assistant Chief: A. D. Melvin, D. V. S.
Chief Clerk: S. R. Burch.
Dairy Division: Henry E. Alvord, C. E., chief; R. A. Pearson, M. S., assistant chief.
Inspection Division: A. M. Farrington, B. S., B. V. S., chief; E. J. Jones, LL.M., assistant chief.
Miscellaneous Division: Richard W. Hickman, Ph. G., V. M. D., chief.
Editorial Clerk: George Fayette Thompson.
Expert in Animal Husbandry: George M. Rommel, B. S. A.
Artist: W. S. D. Haines.
Librarian: Beatrice C. Oberly.

LABORATORIES.

Biochemic Division: E. A. de Schweinitz, Ph. D., M. D., chief; Marion Dorset, M. D., assistant chief.
Expert in Dairy Chemistry: George E. Patrick, M. S.
Pathological Division: Ch. Wardell Stiles, A. M., M. S., Ph. D., chief.
Zoological Division: John R. Mohler, V. M. D., zoologist; Albert Hassall, M. R. C. V. S., acting assistant zoologist.

EXPERIMENT STATION.

Superintendent: E. C. Schroeder, M. D. V.; expert assistant, W. E. Cotton.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., December 2, 1901.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 35 of this Bureau, the manuscripts of eleven miscellaneous articles on animal parasites. Three of the parasites mentioned are Asiatic and are likely to be found affecting some of the troops who have served in China or the Philippines. These three parasites are not familiar to American physicians in general, since they are not usually described in American text-books. One of the other parasites is the common vinegar eel, which is now reported as a parasite of man, and two parasites are discussed which are more or less problematic, but have been mentioned in many zoological and medical writings.

While the work of this Bureau is primarily in the field of veterinary medicine, it is impossible entirely to avoid references to diseases which affect man. This is particularly the case with the animal parasites. Not only is it impossible to draw a sharp line between the parasites of man and those of the domesticated and wild animals, since the organisms in question are in many cases transmissible from one to the other, but as this is the only service in the Government which supports a laboratory devoted to a study of medical and veterinary zoology, we are constantly being called upon by the physicians of the country, the State boards of health, and the various departments of the Government for information or cooperation in this field of science.

Respectfully,

D. E. Salmon,
Chief of Bureau.

Hon. James Wilson,
Secretary.

CONTENTS.

ILLUSTRATIONS.

PLATES.

FIGURES.

ELEVEN MISCELLANEOUS PAPERS ON ANIMAL PARASITES.

TREATMENT FOR ROUNDWORMS IN SHEEP, GOATS, AND CATTLE.[a]

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry.

Sheep, goats, and cattle suffer from the effects of roundworms. This is especially true during wet years. These parasites are found particularly in the lungs, the fourth stomach, and the bowels, and, when present in large numbers, they may result in the death of 5 to 50 per cent of a flock. For some of these parasites, treatment is possible; but for others, treatment has not been found altogether satisfactory.

TREATMENT.

Roundworms which live free in the fourth stomach or in the bowels may be expelled by using various drugs in drenches. A long list of medicines might be mentioned, but many of the drugs most highly recommended frequently fail to effect a cure. Failures are due to several causes: The drug itself may be of little or no value; it may not be administered in the proper dose; it may not be administered in the proper way.

One of the most commonly used drenches is turpentine, but more satisfactory results are obtained from the use of coal-tar creosote, or coal-tar creosote and thymol, or gasoline, or bluestone.

COAL-TAR CREOSOTE.

I have had excellent success in treating sheep, goats, and cattle for the twisted wireworm (*Strongylus contortus*) with a 1 per cent solution of coal-tar creosote. The medicine is easily prepared and quite inexpensive. It may be purchased of a druggist in small quantities of 1 ounce or in pound bottles. One ounce is sufficient for about 20 adult sheep, and the cost of the treatment is less than one-half a cent per head; if creosote is purchased by the pound the cost is reduced to less than one-quarter of a cent per head. If creosote is

[a] Published also as Circular No. 35 of this Bureau, 1901, pp. 1–8.

called for at a drug store, beechwood creosote will usually be dispensed. This is more expensive than the coal-tar creosote, and not so satisfactory in expelling worms.

A 1 per cent solution of coal-tar creosote is made as follows:

	Ounces.
Coal-tar creosote	1
Water	[a] 99

Twisted wireworms (*Strongylus contortus*) taken directly from the stomach of sheep or cattle die in one-half to one and a half minutes when immersed in this solution.

If, in dosing, this liquid enters the lungs, the animal may succumb in a few minutes. If the dosing is performed carefully, as much as 6⅔ ounces may be given to a full-grown sheep without fatal results. In some cases, however, the animal shows ill effects, from which it usually recovers within half an hour. Six ounces were given to a number of sheep without the slightest ill effects. The following table gives the doses of the 1 per cent mixture which were used in about 400 cases without ill effects:

Lambs 4 to 12 months old	2 to 4 ounces (about 60 to 120 c. c.).
Yearling sheep and above	3 to 5 ounces (about 90 to 150 c. c.).
Calves 3 to 8 months old	5 to 10 ounces (about 150 to 300 c. c.).
Yearling steers	1 pint (about 480 c. c.).
Two-year-olds and above	1 quart (about 960 c. c.).

Sheep, goats, and calves which received this treatment showed a marked improvement a few days after receiving a single dose.

In experiments with creosote at Washington, D. C., sheep were drenched with a 1 per cent solution and killed immediately afterwards. Upon opening the fourth stomach, it was found that the wireworms present were dead. In some cases where this was tried later, the wireworms were found to be still alive; but it is believed that the explanation of this fact has now been discovered. (See below, page 13.) Creosote does not appear to have much effect upon the worms below the stomach.

If an overdose is given by mistake, and if the sheep appears severely affected by it, the animal should be placed in the shade. Even in some cases of very severe overdoses, where the animal is practically given up for dead, it may entirely recover within an hour or so.

COAL-TAR CREOSOTE AND THYMOL.

If, in addition to the stomach worms, the animals were suffering from severe infection of bowel worms, such as the hook worms, better results were obtained in the treatment when powdered thymol was added to the creosote. In cases of this kind the creosote solution is prepared, as directed above, and 30 to 80 or even 100 grains of thymol added to each dose after it has been measured.

---

[a] 99 ounces = 6 pints and 3 ounces.

Thymol is expensive, the price varying in different parts of the country. It may be purchased by the ounce, but it is considerably cheaper if purchased by the pound. Avoid using thymol which has become yellowish or reddish and which has run together in the bottle so as to form a solid mass. Powder the crystals and have the druggist measure 30 grains. Give 30 grains to a lamb, about 50 grains to a yearling, and 70 to 80 or 100 grains to older sheep, according to size.

In experiments I have had excellent results with a single dose of the creosote and thymol mixture. If necessary, however, the dose could be repeated after a week.

BLUESTONE.

In the recent experiments with bluestone by Hutcheon, in South Africa, against wireworm disease in sheep, it has been claimed that the same treatment expels tapeworms.

Caution.—Repeated accidents have happened from using too strong a solution or too large doses, or in giving it in such a way that the medicine gained access to the lungs. Dr. Hutcheon's method of procedure, which is here given in detail, is safe in the hands of the average farmer if the directions are followed. The person who gives stronger doses than indicated, or who is careless about the measurements, must take the entire responsibility of the miscarriage of the treatment. It is a good plan to make up a smaller quantity of the solution and try it upon a few sheep before attempting to dose the entire flock.

(*a*) *To prepare the mixture.*—Hutcheon has changed his formula slightly from time to time. On February 21, 1895, he gave the following proportions:

Dissolve 1 pound avoirdupois (1 pound=16 ounces) of good commercial powdered bluestone (sulphate of copper) in 2 imperial quarts (=$2\frac{2}{5}$ quarts, United States) of boiling water; when the bluestone is thoroughly dissolved, add $6\frac{1}{2}$ imperial gallons (=26 imperial quarts =$7\frac{4}{5}$ United States gallons=$31\frac{1}{5}$ United States quarts) of cold water, making in all 7 imperial gallons (or $8\frac{2}{5}$ United States gallons) of water.

In 1897 he changed the strength of the solution to 1 pound of bluestone to "40 whisky bottlefuls of water." This is practically 1 pound to $7\frac{1}{2}$ imperial gallons (=9 United States gallons=about 34 liters, metric) of water.

Use only bluestone which is of a uniform blue color; avoid that which is in conglomerate lumps with white patches and covered with a white crust.

The equivalents of 1 pound avoirdupois and of 7 imperial gallons in other weights and measures are as follows: One pound avoirdupois=1 pound 2 ounces 280 grains of apothecaries' (also is equal to 453.59 grams of metric weight). Seven imperial gallons=8 gallons 3 pints 3 fluid ounces 3 fluid drams 56 minims (or practically 8 gallons $3\frac{1}{4}$ pints,

or $8\frac{2}{5}$ gallons) of apothecaries' (also is equal to 31.804409 liters, metric system).

The farmer is cautioned against guessing at the weights and measures, for this is sure to result either in too strong a solution, which will kill his animals, or too weak a solution, which will fail to be effective. Scales and measures should be tested before they are used. If reliable scales are not at hand, buy the bluestone already weighed and have the exact weight in avoirdupois, apothecaries', or metric system marked on the package.

If a smaller quantity than the above is desired, this can be made up in the proportion of 1 ounce avoirdupois of bluestone to $4\frac{1}{6}$ United States pints of water.

(*b*) *Preparation of the animals.*—Let the sheep or cattle fast twenty to twenty-four hours before dosing. If the fast is thirty hours (longer fasts are dangerous), an extra half gallon or gallon of water should be added to the solution, as animals are more liable to suffer after a long fast.

(*c*) *Size of the dose.*—Hutcheon has several times changed the size of the doses he advises, in some papers basing it on the imperial fluid ounce and in others on the tablespoon. The doses for sheep (in imperial ounces and in tablespoons) given below are his most recent (January 10, 1895) recommendations, and, though based upon a solution with 5 per cent less water than the first solution given above, they may be used for the weaker mixture.

I have given the metric doses to a number of sheep and goats, and the animals showed no ill effects. On the contrary, they gained in weight.

Size of dose for animals at several ages.

Age of animals.	Approximate equivalents.			
	Tablespoons.[a]	Imperial.	United States apothecaries.	Metric.
Lamb 3 months old	1	About ¾ fluid oz	About ¾ fluid oz	About 20 c. c.
Lamb 6 months old	2	About 1½ fluid oz	About 1½ fluid oz	About 40 c. c.
Sheep 12 months old	3	About 2½ fluid oz	About 2 fluid oz	About 60 c. c.
Sheep 18 months old	4	About 3 fluid oz	About 2⅔ fluid oz	About 80 c. c.
Sheep 24 months old	4½	About 3⅓ fluid oz	About 3 fluid oz	About 90 c. c.
Calf 3 months old	4½ to 5	About 3⅓ to 3¾ fluid oz.	About 3 to 3½ fluid oz.	90 to 100 c. c.
Calf 6 months old	5 to 5½	About 3¾ to 4⅛ fluid oz.	About 3½ to 3⅔ fluid oz.	100 to 110 c. c.

[a] "The tablespoon I refer to is the modern, full-sized tablespoon (6 fluid drams). The medicinal tablespoon contains exactly half an ounce."—Hutcheon.

Be careful not to give a two-toothed, young sheep as much as a full-grown, four-toothed sheep. Mistakes may occur in judging the age unless the teeth are examined.

The doses should be measured off in bottles and the point of each dose plainly marked with a file.

(*d*) *Dosing.*—In dosing, use long-necked bottles—as castor oil bottles, Worcestershire sauce bottles, or anchovy sauce bottles—or, better still, a drenching tube.

Let one person place the sheep on its haunches and take its fore legs in his left hand while he steadies the head with the right. Another person inserts the neck of the bottle into the mouth. The head of the sheep should not be raised too high, as in that case the solution may enter the lungs and kill the sheep. A safe rule is to raise the nose to the height of the animal's eyes.

(*e*) *Overdose.*—If, after dosing, any of the sheep seem to be suffering from an overdose—indicated by lying apart from the flock, not feeding, manifesting a painful, excited look and a spasmodic movement in running, walking with a stiff gait, purging, the discharge being a dirty brownish color—take them away from the flock to a shady place and dose with laudanum and milk as follows: For a lamb 4 to 6 months old, 1 teaspoonful of laudanum in a tumbler of milk; for a sheep 1 year old, 2 teaspoonfuls of laudanum in a tumbler of milk. Repeat half the dose in two to three hours, if necessary.

(*f*) *After-treatment.*—The animals should not be allowed water for several hours after receiving their dose.

I have used bluestone on several occasions, and, although it proved more or less successful, it was not so satisfactory as creosote or as gasoline.

GASOLINE.

Gasoline has recently gained considerable reputation as a vermifuge. I have used it in a number of cases and have found the claims made for it to be more or less justified. Three objections, however, arise to its use, and I can not, therefore, consider it an ideal treatment. These objections are:

(1) Not less than three doses, and usually four to six, are required to expel the worms. Its use involves a great expenditure of labor, and it is therefore impracticable on the large ranches.

(2) While several doses are not necessarily injurious to the stock, still, if the doses are large, repeated drenches cause a more or less severe congestion of the bowels. Not only that, but repeated handling of range sheep, with the necessary preliminary treatment of withholding food, is injurious to the animals.

(3) If used on animals suffering from pleurisy, it is likely to be fatal. I have had several fatal cases of this kind.

Nearly all vermifuges are, however, more or less poisonous in one way or another, and gasoline, if properly used, is not particularly dangerous. The necessity of repeating the dose from four to nine times, in order to effect a complete cure, will, however, militate against its general adoption.

If gasoline is used, ammonia also should always be kept on hand. If an animal is suddenly overcome by the effects of gasoline, a small amount (a teaspoonful or so) of aromatic spirits of ammonia may be given in water as a drench, to be repeated if necessary, and will usually result in the recovery of the patient.

The usual doses of gasoline for stomach worms are:

	Ounce.
Lambs	¼
Sheep	½
Calves	½
Yearling steers	1

I have used these doses repeatedly without any serious effects. Each dose is mixed separately in linseed oil, sweet milk, flaxseed tea, or an egg, and given as a drench. If given directly in water, it is more severe on the patient.

An ounce and a half of gasoline has resulted in the immediate death of a full-grown ewe, but in some cases I have given to full-grown sheep as high as 2 to 3 ounces without serious results. I have also given as much as 3 ounces to a yearling steer, and 7 ounces (within an hour) to a horse, without causing serious symptoms. I have also given 3 ounces to a full-grown chicken; the animal became very stupid for a time, but eventually recovered. On the other hand, in one case a yearling steer, in apparently quite healthy condition, succumbed within two minutes after a dose of 1½ ounces. These large doses were given experimentally to determine the danger point, and they should never be used by farmers in treating stock.

In one instance a steer was suddenly overcome because the man who was administering the dose for me accidentally held the head too high and the medicine entered the lungs. The animal fell immediately and appeared to be almost dead. I happened to have a hypodermic syringe with me and some tablets of sulphate of strychnine. A hypodermic injection of this substance was immediately given, and within five minutes the animal was feeding as if nothing had happened. This incident led me to overdose several animals with gasoline and then to try to revive them with hypodermic injections of strychnine. In all cases the treatment was successful. It is thus seen that injury from gasoline may be counteracted by either aromatic spirits of ammonia or by strychnine.

METHODS OF DRENCHING ANIMALS.

The popular method of drenching is with a bottle. The use of a drenching tube is, however, far more satisfactory. A drenching tube may be made by taking an ordinary tin funnel, which may be purchased for 5 or 10 cents, and inserting the narrow end into one end of a rubber tube or hose, say 3 feet long and three-eighths or one-half inch in diameter; into the other end of the rubber tube is inserted a piece of three-eighths-inch brass or iron tubing about 4 to 6 inches long.

The metal tube is placed between the animal's back teeth, and the sheep or calf is allowed to bite upon it. The water or drench is poured into the funnel, which may be held by an assistant or fastened to a post at a convenient height. The man who holds the metal tube

between the animal's teeth can control the animal's head with the left hand, and by holding the tube in the right hand, near the point of union of the rubber and metal tubes, he can easily control the flow of the fluid by pinching the rubber hose. Care must be taken not to hold the patient's nostrils closed, otherwise the dose will enter the lungs.

It is usually advisable to let animals fast twelve to sixteen hours before dosing.

POSITION OF THE ANIMAL DURING DRENCHING.

Different persons prefer to hold the animals in different positions during drenching. Thus (1) the animal may be left standing on all four feet; or (2) it may be placed on its haunches, one man holding its back up against his own body; or (3) it may be placed directly on its back on a sloping piece of ground, its head being in a direct line with its back, and higher than its rump; or (4) it may be placed upon its side, the head being brought around so that the horns are squarely on the ground; the operator may then place one foot on one of the horns (especially in the case of semiwild cattle) and thus aid in holding the animal still.

So far as administering the doses is concerned, the position on the back (3) is by far the easiest in the case of sheep, and the side position with head down (4) is the easiest in dosing cattle; furthermore, in these positions there is much less danger of an accident by getting the dose in the lungs. If animals are dosed standing or on their haunches, the nose should never be allowed to go above the eyes; otherwise the drench may pass down the windpipe into the lungs.

By dosing sheep with water colored red and blue with dyeing material, and killing the animals immediately after the liquid was swallowed, the following results were obtained:

If the dose was given with the sheep standing (1), almost the entire quantity went directly into the fourth stomach; if the sheep was placed on its haunches, the fluid passed in part into the fourth stomach and in part into the first (the paunch); if the sheep was placed directly on its back (3), or if a steer was placed on its side (4) with head down, almost the entire dose passed into the first stomach (the paunch). If the animal, even when standing (1), struggled to a considerable degree, a portion of the fluid passed into the paunch.

It will be immediately apparent that these facts are of practical importance in dosing. If, for instance, gasoline, turpentine, or creosote is used, better results may be expected if the sheep is dosed standing (1).

PREVENTIVE MEASURES.

First. Every ranch should have a hospital pasture situated on high, dry ground, well drained, and without any pools or ponds; this should be supplied with raised troughs for watering and feeding, and the

water supply should come from a well. This pasture should not drain into any pasture in which healthy stock are feeding.

Second. As soon as any sick animal is noticed in the large pasture it should be immediately separated from the healthy stock and taken to the hospital pasture. To allow sick animals to run at large with healthy stock means to permit deliberately the spread of infection in the pastures and thus endanger the uninfected animals.

Third. Proper watering places should be supplied in the large pastures by digging wells and erecting windmills to pump the water into tanks. These tanks should be raised above the ground, so that they can not become contaminated by the animals' droppings being washed into them by rains and floods.

Fourth. Select high, sloping ground for pasture when this is possible. Low pastures should be properly drained.

Fifth. When practicable, burn the pastures regularly, thoroughly, and systematically. The heat from the burning grass will kill many of the eggs and young worms on the grass, ground, and in the droppings.

Sixth. As parasites are more fatal to young animals than to old, a liberal supply of oats or some similar food will aid in giving to young animals strength which will enable them to withstand the infection. A daily allowance of, say, half a pound of oats per lamb ought to reduce the mortality. At first they may not be inclined to eat it, but they will soon become accustomed to it. This simple precaution is reported as very effectual in New Zealand.

Seventh. Keep plenty of salt accessible to the animals. Some men add slaked lime to the salt; others add one part of sulphate of iron to 100 parts of salt. As a matter of experience, salt kills many young worms.

For the minute worms encysted in the fourth stomach, and also for those forming nodules in the bowels, no treatment is known.

For worms in the lungs numerous methods of treatment have been suggested, and success has been claimed for certain remedies. None that I have tried, however, has proved satisfactory.[a]

No practical medicinal treatment is known for the flatworms of the liver, and the treatment for tapeworms in the bowels of ruminants is frequently unsuccessful.

---

[a] See Stiles, 1902, Verminous diseases in cattle, sheep, and goats in Texas <Seventeenth Annual Report of Bureau of Animal Industry (1900), 1902, pp. 356–379.

THE DISINFECTION OF KENNELS, PENS, AND YARDS BY FIRE.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry.

In a recent outbreak of uncinariasis among the blue foxes (*Vulpes lagopus*) of the National Zoological Park, at Washington, D. C., and of infection by the twisted wireworm (*Strongylus contortus*) among the ruminants of the same institution, the problem of disinfecting the yards presented itself. In the diseases in question I had to deal with nematode eggs and embryos, which experience has shown to be difficult to kill by the ordinary methods of disinfection.

Experiments and experience in Texas have shown fire (by burning the pastures) to be a cheap and practical means of disinfecting a pasture infested with these two genera (*Uncinaria* and *Strongylus*), and the question arose as to how fire could be safely used for the same purpose in pens, kennels, and yards.

It is evident that any method which involved the pouring around of an inflammable oil was excluded as being too dangerous and too expensive. The use of a gasoline burner, such as is used in repairing asphalt pavements, suggested itself, and was immediately tried. Unfortunately, the instrument is clumsy and difficult to handle, but the heat it developed on the ground showed that the general principles involved were applicable. The surface of the ground was thoroughly scorched, and all particles of wood, straw, pine needles, etc., were burned. From the temperature to which the surface of the ground was heated (tested by the hand), it is clear that any superficially situated nematode eggs or larvæ would be immediately killed. As stated elsewhere, I have found in Texas that the burning of the grass on the prairie generates sufficient heat practically to disinfect the pastures of parasitic nematodes—a conclusion based, not upon observing the dead nematodes, but upon the fact that an outbreak of nematode infection in cattle may be checked by this method. The conclusion appears justified, therefore, that outbreaks of nematode disease in kennels, zoological gardens, etc., can be checked by similar measures.

Owing to the price charged for the asphalt burners, and to their unwieldiness, I began the construction of a new and cheaper apparatus, one more simple in form and more convenient to handle; but before this instrument was completed Dr. L. O. Howard, entomologist of this Department, called my attention to an apparatus already in existence which will apparently answer the purpose. The instrument in question is the so-called "cyclone burner," and is described by Forbush[a] as follows:

"Professor Fernald had recommended in 1889 that the eggs of the moth be scraped from the trees and burned. This was the most effectual method of egg-killing pursued by the first commission. During the spring of 1891 it was used by the second

[a] Forbush & Fernald, 1896, The Gypsy Moth, *Porthetria dispar* (Linn.). A report of the work of destroying the insect in the Commonwealth of Massachusetts, etc., Boston, pp. xii+495+c. 66 plates, 5 maps, and figs. in text.

commission and later by the employees of the State board of agriculture. The eggs were scraped off or cut away from the objects upon which they rested, placed in tin cans, and burned in stoves or brush fires. A fierce heat is required to insure their destruction. When exposed to such heat they finally burst with a snapping like a bunch of miniature firecrackers or the cracking of corn in a popper. Whenever the eggs were very numerous in undergrowth or waste land, fire was run through the dead leaves and débris as an experiment; but this method seemed to have little effect, as the heat was not sufficiently intense. The hairy covering of the egg clusters seems to possess remarkable nonconductive properties, rendering the eggs almost impervious for a time to sudden intense heat. Even with the hottest fire that can be applied to the egg clusters, some minutes are required to destroy them utterly. A running brush fire merely scorched the outside of the cluster, killing perhaps a few of the eggs in the external layer, but leaving the majority uninjured. Experiments were next made with crude petroleum, by spraying it over the ground and vegetation by means of watering pots and then igniting it. The fire thus made was fierce enough to destroy the small undergrowth and the upper layer of leaves, together with most of the eggs, but such egg clusters as remained under roots or rocks were not injured. Considerable oil was wasted by soaking into the ground, and the remainder did not give the degree of heat which is obtained by atomizing. Experiments were then made with a view of perfecting a burning machine which would incinerate all undergrowth in a given tract. The first experiments were not entirely successful, as the machines were either too cumbersome or could not be used on rough or uneven ground. It was found necessary to provide an apparatus which would distribute the oil in a spray, as when thus thrown in fine particles in the air and ignited, it formed an extremely hot gas flame and was consumed to the best advantage. For economy's sake, such an apparatus must be light enough to be carried and operated by two men, as wagons could not be driven over much of the ground upon which this work was done. Experiments were made with the cyclone nozzle. An oil spray from this nozzle, when ignited, was found to give a very hot and effective flame. Crude oil was first used as a burning fluid, but as it is very objectionable on account of its rank odor, paraffin-gas oil was substituted later. This oil has less odor and burns to better advantage, but is somewhat more expensive. A 15-gallon tank, which could be readily carried about by two men, was provided. On such a tank a Johnson pump, with a fine strainer placed over the suction pipe, was mounted and a short hose, of the kind made for the delivery of oil, was attached. Ordinary rubber hose is worthless for such a purpose, as it is soon destroyed by the corrosive action of the oil, and in the meantime the disintegrated particles frequently clog the nozzle.[a] A pole, consisting of an iron pipe 12 feet long, braced by being surrounded by wood for three-fourths of its length, was coupled to the hose. (See fig. 1.) No solder could be used in the fittings of the pipe or nozzle, as the fierce heat of the flame would fuse it. The wooden cylinder into which the pipe was thrust was 1¼ inches in diameter. The wood, being a nonconductor of heat, was of great convenience in

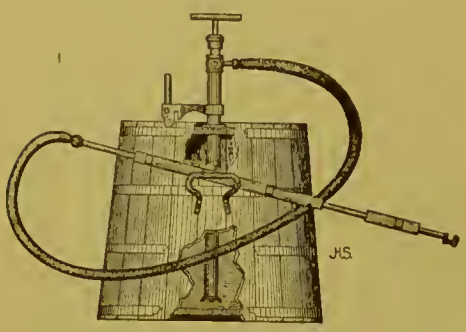
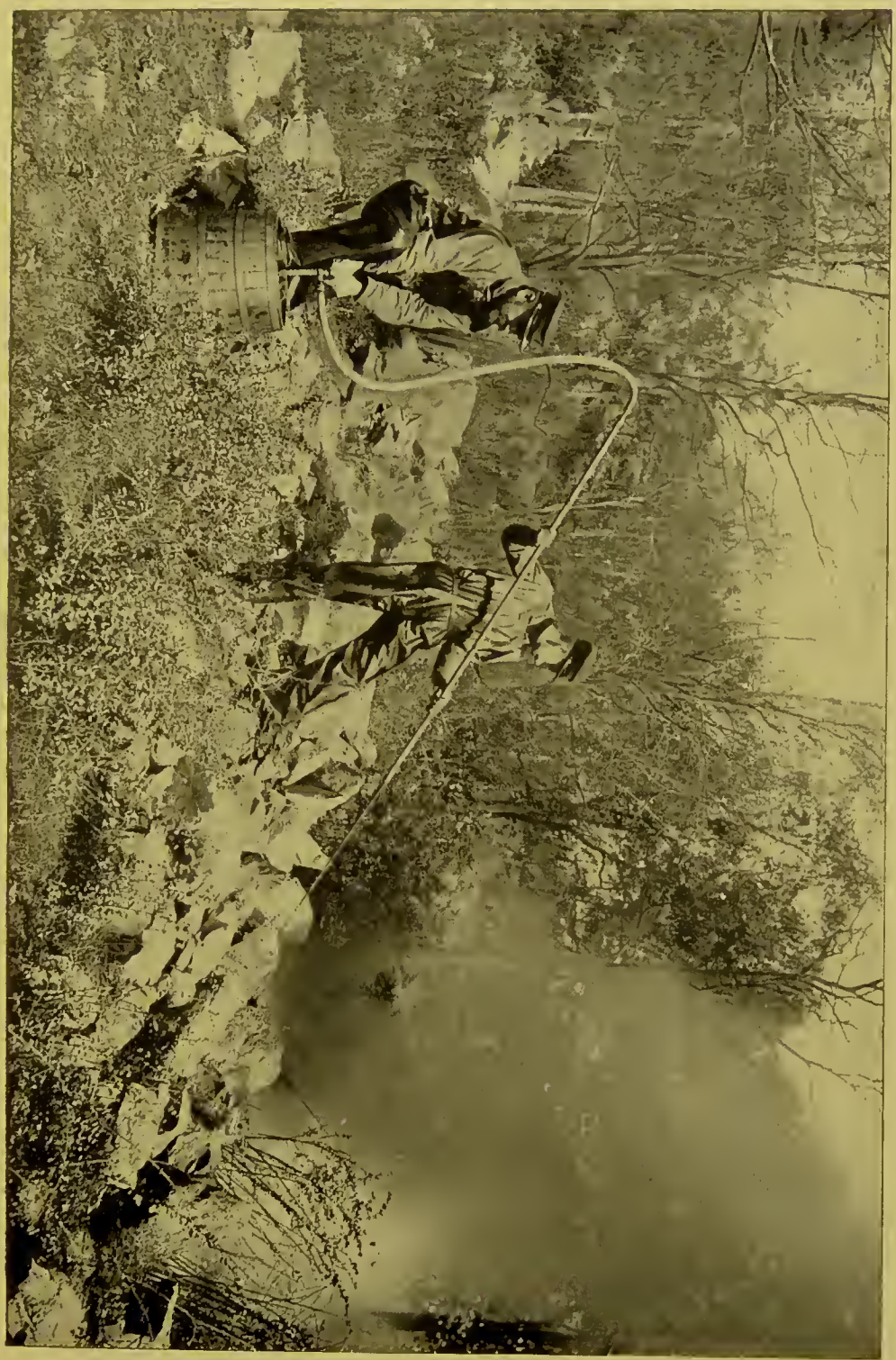
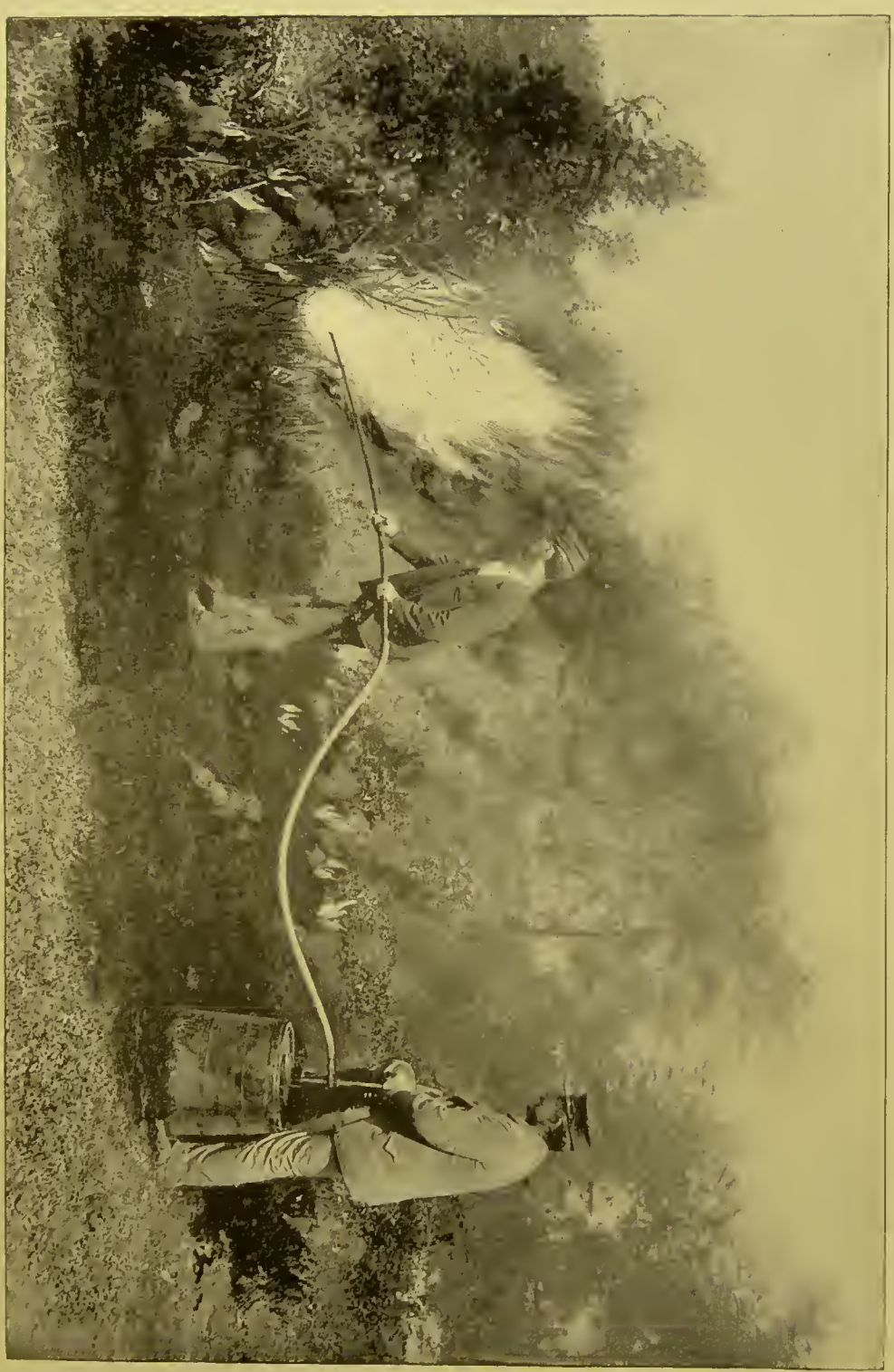


FIG. 1.—Tank, pump, and hose for spraying with oil.

[a] The best oil hose that can be obtained will soon become corroded, clogging the nozzle. If an automatic clearing nozzle could be devised which would withstand the heat, much time might be saved which is now necessarily used in clearing the nozzle.



Spraying with Burning Oil.



Spraying with burning Oil.

handling the pole. The end of the pipe was fitted with a cyclone nozzle. The aperture of this nozzle is very small, hence the value of the strainer before mentioned, which prevents the entrance of foreign substances with the oil and a consequent clogging of the nozzle. The two men handling this apparatus filled the tank with oil and then carried it to the spot where the burning was to be done. One man then operated the pump while the other handled the pole and nozzle. As soon as the pump was started a fine spray of oil was thrown into the air and ignited by a match. By means of the pole the resulting fierce flame was carried among the undergrowth and over the ground, destroying every living thing in its path. When this work was carefully done no eggs escaped, except such as were hidden in ledges or holes in the ground. An attempt was made also with this apparatus to destroy eggs which had been deposited in stone walls. (See Pl. I.) Though this was partially successful, in so far as the fire reached and destroyed most of the eggs, those which were deposited under the lower stones of the wall were unharmed, even though in many cases the stones were cracked and broken by the heat. As it sometimes became necessary to use this apparatus in burning out walls near growing crops, a sheet-iron screen was set up between the flame and the growing vegetables, to protect them from the heat, being moved along the wall as the work progressed. Burning was thus done without any resultant injury to the gardens. This machine, which has been named the 'cyclone burner,' would be most useful in checking invasions of crawling pests, like the army worm." (See Pl. II.)—*Forbush & Fernald, 1896, pp. 119–121.*

It is well known that there is a high mortality among the animals in zoological gardens, and the expression that "wild animals do not do well in confinement" is common in zoological writings. From the postmortem examinations I have made on animals which have died in the National Zoological Park in this city, I am convinced that parasitic diseases play no insignificant rôle in this death rate. This is perfectly natural. In nature an animal roams over a considerable surface of ground, and the infection he spreads is therefore scattered. In a zoological garden this infection, with eggs and embryos of parasitic worms passed in his droppings, is necessarily confined to a small area, hence dirt pens are areas of concentrated infection. Naturally, therefore, the mortality of animals due to parasitic worms, particularly to nematodes not requiring an intermediate host, will be high. In order to reduce this mortality I suggest that, where practicable, at intervals of ten to thirty days, especially during warm, moist weather, the ground of all pens be burned by fire.

It is understood, of course, that burning with a flame of this kind will disinfect only the surface of the ground, unless the flame is held in one place for some seconds or minutes.

Complaint has been made that there is a high mortality from uncinariasis among high-bred pups. The use of this flame in kennels ought to reduce this mortality practically to nothing, and I see no reason why the same general method of disinfection, modified to suit the particular conditions at hand, should not be used on the seal rookeries and fox farms of the Alaskan islands.

EIMERIA STIEDÆ (LINDEMANN, 1865), CORRECT NAME FOR THE HEPATIC COCCIDIA OF RABBITS.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry.

It seems to have been quite generally overlooked that Lindemann named the hepatic coccidium of rabbits fourteen years earlier than Leuckart and thirteen years earlier than Rivolta. This results in an unfortunate change in the specific name. There must also be a change in the generic name, owing to a recent decision of the International Zoological Congress.

At present the synonymy of the genus and the species stands as follows:

Genus Eimeria.

1875: *Eimeria* Schneider; type, *E. falciformis* (Eimer); intestine of mice.
1878: *Psorospermium* Rivolta (not Müller, 1841, p. 487).
1878: *Cytospermium* Rivolta (at least in part).
1879: *Coccidium* Leuckart; type, *C. oviforme;* liver of rabbits.
1894: *Pfeifferia* Labbé (not Gray, 1853). Contains *Coccidium perforans.*
1896: ?*Goussia* Labbé; type, *Coccidium variabile* Thélohan.
1899: *Pfeifferella* Labbé=*Pfeifferia* Labbé renamed.
Possibly other generic names belong here.

Species Eimeria Stiedæ (Lindemann, 1865) Stiles, 1902.

1865: *Monocystis Stiedæ* Lindemann, based upon Stieda's figs. 4–5, pl. 3, Arch. f. path. Anat., 1865; liver of rabbit.
1878: *Psorospermium cuniculi* Rivolta.
1878: "*Psorospermium uniculi*" Rivolta (misprint).
1878: ?*Cytospermium hominis* Rivolta, based upon Eimer's two cases in man.
1879: *Coccidium oviforme* Leuckart; liver of rabbit.
1879: ?*Coccidium perforans* Leuckart; intestine of rabbit.
1879: *Gregarina ovalis* Baransky; liver, intestine, mesentery glands, and kidneys of rabbit.
1893: *Coccidium cuniculi* (Rivolta, 1878) Railliet.
1893: ?*Coccidium hominis* (Rivolta, 1878) Railliet.
1896: *Pfeifferia princeps* Labbé (eimerian stage of *Coccidium perforans* and *C. oviforme*).
1899: ?*Pfeifferella princeps* (Labbé, 1896) Labbé (eimerian stage of *Coccidium perforans*).
1899: *Pfeifferella princeps* var. Labbé (eimerian stage of *Coccidium oviforme*).
1902: *Eimeria Stiedæ* (Lindemann, 1865) Stiles, 1902, p. 18.

EIMERIELLA, NEW GENUS OF COCCIDIA.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry.

A swarming stage of a parasite of a mouse was described by Eimer in 1870 as *Gregarina falciformis.* Schneider (1875) took this species as basis for a new genus—*Eimeria.* In 1879 Leuckart proposed the genus *Coccidium* for a parasite in rabbits which he thought was gener-

ically distinct from *Eimeria*. Comparatively recent investigations have now demonstrated that *Eimeria* represents a nonsexual stage of animals which are congeneric with the animals of which *Coccidium* represents the sexual stage. Accordingly, the genus *Coccidium* now disappears, and all of its members should be transferred to *Eimeria*—*E. Stiedae*, *E. bigemina*, *E. gasterostei*, *E. truncata*, *E. tenella*, *E. Delagei*, *E. propria*, etc.

Several nonsexual forms, for which the sexual stages are uncertain, have been described as belonging to the genus *Eimeria*, and it develops that one species, *E. nova*, runs through a sexual stage which presents characteristics similar to the nonsexual stage. This fact has led to the recognition of *Eimeria* for *E. nova*, while *Coccidium* has been retained for the other species. Such a procedure, however, can not be adopted, as *Eimeria* (1875) is based upon a form (*E. falciformis*), which passes through the coccidium stage. Hence *Eimeriella* is here proposed as a new genus, with *Eimeriella nova* (Schneider, 1881) as type species.

NOTES ON PARASITES—58-62.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry,
and
Albert Hassall, M. R. C. V. S.,
Acting Assistant Zoologist of Bureau of Animal Industry.

58: Levinseniella, new name for the trematode genus Levinsenia Stossich, 1899 (not Mesnil, 1897).

In 1899 Stossich proposed the generic name *Levinsenia* for a trematode genus of the family Fasciolidæ. The genus has been used by several authors, all of whom have overlooked the fact that the name *Levinsenia* is preoccupied by Mesnil (Bull. scient. de la France et de la Belgique, Paris, v. 30, p. 93).

We have called Professor Stossich's attention to the fact that his name is a homonym and suggested that he propose a new one. In reply he has requested us to make the change. Accordingly *Levinseniella* is here proposed as substitute.

The synonymy and bibliography to date for the genus are as follows:

Levinseniella Stiles & Hassall, 1901.

1899: *Levinsenia*[a] Stossich, 1899, pp. 7, 9 [not Mesnil, 1897, p. 93].—Lühe, 1899, p. 538.—Idem, 1900, p. 508.—Looss, 1899, pp. 617, 620.—Braun, 1900, p. 6.—Odhner, 1900, p. 13.

---

[a] Bibliographic references cited in this article by date may be found in full in any journal which gives the helminthological literature, for instance, the Zoologischer Anzeiger. They will also appear in full in the Index-Catalogue of Medical and Veterinary Zoology, now being prepared for press, in the Zoological Laboratory of the Bureau of Animal Industry.

1901: *Levinseniella* STILES & HASSALL, in Ward, 1901, May, pp. 176, 181, 182, 183, 184.—Stiles & Hassall, 1902, pp. 19–20; *Levinsenia* STOSSICH, renamed.

Original species of *Levinsenia: Distoma opacum* Ward; *D. brachysomum* Creplin; *D. pygmaeum; D. macrophallos.*

TYPE SPECIES.—*Levinseniella brachysoma*, designated by Lühe, 1899, p. 538; also independently by Looss, 1899, p. 622. The former genus *Levinsenia* must probably be divided.[a]

59: HÆMATOLŒCHUS SIMILIGENUS, NEW NAME FOR THE TREMATODE H. SIMILIS LOOSS, 1899.

A curious and unfortunate case of nomenclature is presented on page 602 of Looss's (1899) recent paper on Egyptian trematodes.

Looss has proposed a new genus, *Haematoloechus*, for several species of distomes. One of these is a new species, *H. similis*, which he separates from *Distoma variegatum*. The name *similis* would in itself have been an unfortunate selection, because of liability of confusion with another species in the same family, *Distoma simile*, yet it would have been valid under ordinary circumstances. Unfortunately, however, Looss has named his new species both *D. simile* and *H. similis* in the same paper, thus bringing into the world a stillborn homonym (*D. simile* Looss, 1899, not Sonsino, 1890). As a substitute for Looss's name we here propose *Haematoloechus similigenus.*

The synonymy and bibliography of the species are as follows:

HÆMATOLŒCHUS SIMILIGENUS.

1899: *Distomum simile* Looss, 1899, p. 602, not Sonsino, 1890.

1899: *Hæmatolœchus similis* (Looss, 1899) Looss, 1899, pp. 601, 602.—STILES, 1901, p. 178.

1902: *Hæmatolœchus similigenus* STILES & HASSALL, 1902, p. 20, new name for *H. similis.*

Type host and type locality not determined.

60: BOTHRIOCEPHALINÆ, PTYCHOBOTHRIINÆ, AND MESOGONINÆ FROM A NOMENCLATURAL STANDPOINT.

Lühe (1899) has recently placed helminthologists under obligations to himself through his work on the family Bothriocephalidæ and other parasites. Unfortunately, however, we find it necessary to differ with him in several nomenclatural questions. Some of these are discussed in a recent paper by Stiles, and we here direct attention to three other cases.

Lühe (1899) and Braun (1900) have adopted the family names "Bothriocephaliden" and "Bothriocephalidæ." By so doing they, of course, accept *Bothriocephalus* as type genus of the family. Lühe, however,

[a] Ward (1901, pp. 175–185) has proposed *Microphallus* with *Dist. opacum* as type; and Jägerskiöld (1901, Dec., p. 982) has recently used *Spelotrema* with *Dist. pygmæum* as type.

proposes the name Ptychobothriinæ for the subfamily to which the type genus *Bothriocephalus* belongs, and Braun follows him in this error. The name of the typical subfamily should, of course, correspond to the name of the family and of the type genus. Bothriocephalinæ, which was a name in good standing at the time Lühe proposed Ptychobothriinæ, should therefore be retained.

Ariola (1900) has erred in naming this subfamily Mesogoninæ; this name would be based upon a genus *Mesogonus*, which does not exist in this subfamily. *Mesogonimus* Monticelli is a trematode genus, the correct name of which is *Clinostomum*. Ariola's nomenclature can not, of course, be accepted, as it is contrary to the code.

Our Bureau of Animal Industry catalogue contains the following references to the names in question:

SUBFAMILY BOTHRIOCEPHALINÆ.

1891: *Bothriocephalinæ* MONTICELLI & CRETY, 1891, p. 390.—MONTICELLI, 1892, p. 107.—GAMBLE, 1896, p. 91.—STILES, 1896, pp. 23, 25.—IDEM, 1898, p. 85.—PERRIER, 1897, p. 1847.—STILES & HASSALL, 1899, pp. 100, 167.—BRAUN, 1900, p. 1659.—ARIOLA, 1900, pp. 378, 382.

1899: *Ptychobothriinæ* LÜHE, 1899, pp. 41–46.—IDEM, 1900, p. 210.—BRAUN, 1900, pp. 1675, 1683, 1691–1693.—ARIOLA, 1900, pp. 378, 398, 401.

1899: *Ptychobothriina* LÜHE, 1899, p. 46 (misprint for *Ptychobothriinæ*).

1900: *Mesogoninæ* ARIOLA, 1900, pp. 380, 382, 388 (type genus, *Bothriocephalus*).

The synonyms in the above table are not all coequal in the sense of containing the same species in all bibliographic references. The conception of the limits of a subfamily (the genera most closely related to the type genus of the subfamily) very naturally varies with different authors. As the subfamily name is tied to a given generic name, it must, however, follow that name, no matter how the group is divided or restricted.

61: THE TYPE SPECIES OF ANCHISTROCEPHALUS.

In 1854 Diesing proposed *Polyonchobothrium* as subgenus of *Onchobothrium*. It contained only one species, *Tetrabothrium polypteri*, which he forthwith renamed *Onchobothrium* (*Polyonchobothrium*) *septicolle*. Accordingly, *polypteri* is unquestionably the type of *Polyonchobothrium*.

In 1890 Monticelli proposed the genus *Anchistrocephalus* to contain *Bothriocephalus microcephalus* and *Tetrabothrium polypteri*, although he knew that *Polyonchobothrium* was based upon *polypteri*.

Lühe, in 1899, designated *B. microcephalus* as type of *Anchistrocephalus* (which he changed to *Ancistrocephalus*), evidently on the ground that this species is better known than *polypteri*. He rejected *Polyonchobothrium*.

Braun follows Lühe, but explains that if *polypteri* and *microcephalus* prove to be generically related, *Anchistrocephalus* will fall as synonym of *Polyonchobothrium*.

With reference to the type species, we find it necessary to take issue with our colleagues. This case is fully covered by the B. A. Code and by precedent, and neither Lühe nor Braun has shown wherein the B. A. Code is unjust. Further, Braun has followed the ruling of the B. A. Code in other instances in the same paper. His reason for making an exception in this case is not clear, and to our minds no exception can be allowed.

Monticelli's *Anchistrocephalus* (proposed without the designation of a type) contains the type species of an earlier genus. His proposal of this name was therefore a deliberate substitution of a newer for an older name, and the older name was known to him and cited by him. *Anchistrocephalus* therefore takes the same type as *Polyonchobothrium* (namely, *polypteri*), and Lühe's designation of *microcephalus* as type must be rejected on the ground that Monticelli included a type in his renamed genus.

Lühe mentions the fact that little is known concerning *P. polypteri*. This is unfortunate, but does not alter the case.

The following references to the generic names in question are taken from our Bureau of Animal Industry catalogue:

1854: *Onchobothrium* (*Polyonchobothrium*) Diesing, 1854, p. 33.
1863: *Polyonchobothrium* (Diesing) Diesing, 1863, pp. 215, 262–263.
1890: *Anchistrocephalus* Monticelli, 1890, pp. 202, 208.—Braun, 1900, pp. 1657, 1674.
1899: "*Ancistrocephalus* Monticelli," of Lühe, 1899, p. 37.—Braun, 1900, pp. 1657, 1683, 1694–1695.

62: Tricuspidaria or Triænophorus?

In 1793 Rudolphi proposed the cestode genus *Tricuspidaria* with *Tr. nodulosa* as type. In suggesting the name he says: "Omnibus hisce commotus proprio genera *Triaenophorus* vel *Tricuspidaria* eum enumerari mallem, num recte, penes Helminthologos sit judicum."

Of the two names used, he distinctly selects *Tricuspidaria* in connection with his diagnosis, and with this name alone does he combine the specific name *nodulosa*. In his next two articles (1801–1803, 1808–1810) he retains *Tricuspidaria*, with full knowledge of the fact that this name was also used (1794) for a genus of plants. Lamarck also retains *Tricuspidaria* in 1816. Despite the fact that, as the first reviser, Rudolphi had thus established beyond doubt the right of *Tricuspidaria* over *Triaenophorus*, he himself changed in 1819 to *Triaenophorus*. Since Rudolphi's time some authors have used one name, some the other. Lühe in his revision selected *Triaenophorus*, and Braun (1900) has followed Lühe, explaining that his reason for doing so is the page-precedence of *Triaenophorus* in 1793. In this ruling our German colleagues have followed the Code of the German Zoological Society, which differs from the principle ("first reviser") usually adopted. They have taken sides with some of the best-informed nomenclaturists in the world, hence they are in good company.

This principle of "page precedence" is an excellent one when all other things are equal, but when admitted as of more importance than other factors we must respectfully differ with our colleagues and take our position with those nomenclaturists who admit the principle of the "first reviser."

It is not clear to us why Lühe and Braun have selected the rule of "page precedence" to cover this particular case, yet have not carried out this rule consistently in reference to all the genera treated in the same papers. Thus, if "page precedence" is appealed to in order to establish *Triaenophorus* over *Tricuspidaria*, consistency calls for the acceptance, as type of every genus, the first species mentioned in connection with that genus. Neither Lühe nor Braun consistently carries out this plan; hence "page precedence" must be construed as being a convenience with them rather than a principle. The "first reviser," however, is a principle, not a convenience, which we follow; hence we must reject *Triaenophorus* and accept *Tricuspidaria*.

According to our Bureau of Animal Industry catalogue, the names in question occur as follows:

SUBFAMILY TRICUSPIDARIINÆ, NEW NAME.

1889: *Triænophoridæ* LÖNNBERG, 1889a, pp. 40–42.
1899: *Triænophorinæ* LÜHE, 1899a, pp. 35–41, 55.—IDEM, 1899b, p. 703.—IDEM, 1900a, p. 99.—IDEM, 1900b, p. 210.—ARIOLA, 1900, p. 378.
1902: *Tricuspidariinæ* STILES & HASSALL, 1902, p. 23.

GENUS TRICUSPIDARIA RUDOLPHI, 1793.

1793: *Triænophorus* vel *Tricuspidaria* RUDOLPHI, 1793, p. 44.
1793: *Tricuspidaria* RUDOLPHI, 1793, pp. 43–44; type and only species, *Tænia nodulosa*=*Tricuspidaria nodulosa*.—IDEM, 1802, pp. 99–102.—IDEM, 1809, pp. 7, 25–26, 32, 42, pl. 9, fig. 3.—IDEM, 1810, pp. 32–37.—LAMARCK, 1816, p. 169.—OLFERS, 1816, pp. 38–39.—CUVIER (1817, p. 45).[a]—TSCHUDI, 1837, p. 24.—COBBOLD, 1859, pp. 115–116.—IDEM, 1859, pp. 202–203.—KNOCH, 1862, pp. 8, 28, 37.—LEUCKART (Hoyle, trans.), 1886, p. 388.—MONTICELLI, 1892, p. 108.—GAMBLE, 1896, p. 91.
1793: *Triænophorus* RUDOLPHI, 1793, p. 44.—[See also RUDOLPHI, 1809, p. 25, as syn. of *Tricuspidaria*].—IDEM, 1819, pp. 135, 467–468, 598.—BREMSER, 1824, p. 138.—L'HERMINIER, 1826, p. 11.—DE BLAINVILLE (1828, p. 596).—CREPLIN, 1829, pp. 79–80.—IDEM (1839, p. 295).—MEHLIS, 1831, pp. 190–191.—BURMEISTER, 1837, p. 526.—SIEBOLD, 1837, p. 201.—FISCHER de Waldheim, 1840, p. 160.—DUJARDIN, 1845, pp. 625–626.—WALLENSTEDT, 1847, p. 6.—DIESING, 1850, pp. 480, 604–605.—IDEM, 1863, pp. 214, 246–249.—BAIRD, 1853, pp. 93–94.—GOLDBERG, 1855, p. 127.—MOLIN, 1858a, p. 134.—IDEM, 1858b, p. 292.—IDEM (1861, p. 236).—CARUS, 1863, p. 482.—LEUCKART, 1863, pp. 162, 415,421.—IDEM, 1879, p. 74.—LEUCKART, HOYLE, 1886, pp. 56, 275, 302, 309, 328, 375, 377, 675, 680, 682, 715.—WILLEMOES-SUHM, 1869, pp. 94–96.—KAHANE, 1880, p. 251.—BRAUN, 1883, pp. 81, 102, 104.—IDEM, 1895, pp. 168, 174.—ZSCHOKKE, 1884, p. 160.—LÖNNBERG, 1889a, pp. 40–42.—ZER-

[a] Where dates are inclosed in parentheses, the reference has been taken from the catalogue but has not been reverified.

NECKE, 1895, pp. 7, 17, 18, 19, 29, 35, 40, 50, 61, 62, 63, figs. 43, 44, 45, 68, 71.—GAMBLE, 1896, p. 91.—BETTENDORF (1897, p. 327).—LÜHE, 1897, pp. 743, 744.—IDEM, 1899a, pp. 33, 34, 35, 37–38, 55.—IDEM, 1899b, p. 703.—IDEM, 1900, pp. 54, 56, 58, 96, 98, 99, 107–108.—ARIOLA, 1900, pp. 378, 379.—SAINT-REMY, 1900, p. 293.—WOLFFHÜGEL, 1900, p. 133.—VAULLEGEARD, 1901, p. 109.

1881: *Triœnophorus* of MÉGNIN, 1881, pp. 419–426 (misprint for *Triænophorus*).

SPECIES TRICUSPIDARIA NODULOSA (PALLAS) RUDOLPHI.

1793: *Tricuspidaria nodulosa* (Pallas) RUDOLPHI, 1793, p. 44.—IDEM, 1802, pp. 99–102.—IDEM, 1810, pp. x, 32–37, 238, pl. 9 [1809], figs. 6–11.—[See also RUDOLPHI, 1819, p. 135, as syn. of *Triænophorus nodulosus*].—LAMARCK, 1816, p. 169.—OLFERS, 1816, pp. 30, 38–39.—VAN BENEDEN, 1850, pp. 164–168, pl. 22, figs. 1–5.—KÜCHENMEISTER, 1855, p. 30.—COBBOLD, 1859a, pp. 115–116, 1 fig.—IDEM, 1859b, pp. 202–203, 1 fig.—IDEM, 1879, p. 470.—KNOCH, 1862, p. 19.—MÉGNIN, 1881a, pp. 419–426, pl. 25.—IDEM, 1881b, pp. 924–925.—ARIOLA, 1900, p. 460.

1819: *Triænophorus nodulosus* (Pallas) RUDOLPHI, 1819, pp. 135, 467–468, 598.—BREMSER, 1824a, p. 9, pl. 12, figs. 4–16.—IDEM, 1824b, p. 138.—DE BLAINVILLE (1828, p. 596).—BURMEISTER, 1837, p. 526.—CREPLIN (1839, p. 295).—FISCHER de Waldheim, 1840, p. 160.—DUJARDIN, 1845, pp. 625–626.—DIESING, 1850, pp. 604–605.—IDEM, 1863, pp. 247, 249.—BAIRD, 1853, pp. 93–94.—SIEBOLD, 1854, pp. 36, 41, 42, 43, 70–71.—THOMSON, 1855, p. 190.—MOLIN, 1858a, p. 134.—IDEM, 1858b, p. 292.—IDEM (1861, p. 236).—POLONIO (1860, p. 227).—KNOCH (1862, p. 32).—CARUS, 1863, p. 482.—LEUCKART, 1863, p. 415.—WILLEMOES-SUHM, 1869, pp. 95–96, pl. 10, figs. 2–4.—KAHANE, 1880, pp. (192, 197).—MÉGNIN, 1881, pp. 924–926.—BRAUN, 1883, p. 82.—ZSCHOKKE, 1884, pp. 158, 163.—SCHMIDT, 1888, pp. 179–186.—LÖNNBERG, 1889a, pp. 40–41, fig. 20.—STOSSICH, 1890a, p. 52.—IDEM, 1890b, p. 135.—IDEM, 1900, p. 6.—FRANCAVIGLIA, 1892, p. 32.—KOWALEWSKI, 1894a, p. 4.—IDEM, 1894b, p. 223.—FUHRMANN, 1895, p. 220.—ZERNECKE, 1895, p. 6.—GAMBLE, 1896, pp. 84, 85.—LÜHE, 1897, pp. 742, 746.—IDEM, 1899a, pp. 31, 32, 33, 34, 38, 41.—IDEM, 1899b, pp. 703, 709, 710, 712–714, 717.—IDEM, 1900, pp. 47, 50, 52, 53, 54, 55, 56, 57, 65, 66, 67, 68, 69, 72, 73, 76, 79, 85, 86, 87, 90, 91, 95, 96, 98, 108, pl. 4, fig. 2; pl. 7, figs. 23, 24, 28.—MÜHLING, 1898, p. 35.—SAINT-REMY, 1900, p. 296.

1881: *Triænophorus nodulosus* of MÉGNIN, 1881, pp. 419–426, pl. 25.

TWO TREMATODES (MONOSTOMULUM LENTIS AND AGAMODISTOMUM OPHTHALMOBIUM) PARASITIC IN THE HUMAN EYE.

By CH. WARDELL STILES, PH. D.,
Pathologist of Bureau of Animal Industry.

[Plate III, figures 2–5.]

Two trematodes (*Monostomulum lentis* and *Agamodistomum ophthalmobium*) have been reported for the human eye. These worms are referred to in many medical, veterinary, and zoological works, and one might be led to assume that they were of some importance. As a matter of fact, while they are of some historic interest, it must be admitted that they are more or less problematic to the zoologist; to the medical profession they must be viewed as medical curiosities rather than organisms of any practical importance.

During certain recent studies I have been obliged to consult a number of books in which these helminths are mentioned, and, noticing the various views concerning them, it has appeared to me advisable to bring together in English our entire knowledge concerning the parasites in question. The bibliographic references here cited are taken from the card catalogue of the Zoological Laboratory of the Bureau of Animal Industry, and may be considered the most complete bibliography and synonymy of these two worms as yet published. So far as I am aware, the statements here made are practically a complete presentation of the various views thus far expressed regarding the two problematic parasites.

Collective Group Monostomulum[a] Brandes, 1892.

This is an artificial collective genus proposed by Brandes to receive agamic monostomes, the exact specific identity of which can not be recognized.

The Eye Monostome (Monostomulum lentis[b] Gescheidt, 1833) Brandes, 1892, of Man.

Specific diagnosis.—*Monostomulum:* One-tenth of a line (0.3 mm.) long.
Habitat.—In crystalline lens of eye of man (*Homo sapiens*), in Odessa.

Although quite a number of references to this parasite are found in medical and zoological literature, practically nothing is known concerning it. All discussions of the worm are based directly or indirectly

---

[a] Bibliography.

1892: *Monostomulum* Brandes, 1892, p. 510.

[b] Synonymy and Bibliography.

?1758: *Fasciola hepatica* Linnæus (see below, p. 28).
1832: "Monostomen" Nordmann, 1832, p. ix.
1833: *Monostoma lentis* Gescheidt, 1833, pp. 421, 445.—Eiss, 1838, p. 38.—Rayer, 1843, pp. 114, 116, 149.—Güntiher, 1858, p. 205.—Weinland, 1858, p. 86.—Idem, 1859, p. 280.—Cobbold, 1876, p. 211.—Vogt, 1878, p. 13.—Küchenmeister & Zürn, 1882, p. 285.—Braun, 1883, p. 59.—Davaine, 1887, p. lxxiii.—Blanchard, 1888, pp. 542–543.—Iijima, 1889, p. 122.—Mosler & Peiper, 1894, p. 185.—Dunglison, 1893, pp. 821, 1174.—Idem, 1895, pp. 821, 1174.—Wood & Fitz, 1897, p. 335.
1850: *Monostomum lentis* (Gescheidt, 1833) Diesing, 1850, p. 329.—Idem, 1858, p. 24.—Küchenmeister, 1855, pp. 180–182.—Idem, 1857, pp. 244–246.—Swart, 1862, p. 34.—Leuckart, 1863, pp. 526, 633–634.—Idem, 1889, p. 175.—Idem, 1894, pp. 446–448.—Wagner, 1876, p. 122.—Vogt, 1878, p. 10.—de Bonis, 1882, p. 180.—Davaine, 1887, pp. 820, 822.—Braun, 1893, p. 870.—Idem, 1895, p. 155.—R. Blanchard, 1895, pp. 729, 733.—Gamble, 1896, p. 63.—Huber, 1896, p. 501.—Moniez, 1896, pp. 86, 152, 153.—Kholodkovski, 1898, p. 34.—Stiles, 1898, p. 48.
1860: *Festucaria lentis* (Gescheidt, 1833) Moquin-Tandon, 1860, p. 349.—Idem, 1861, p. 375.
1864: "*Distoma ophthalmobium* Diesing, 1850," of Cobbold, 1864, pp. 191–192, in part.
1892: *Monostomulum lentis* (Gescheidt, 1833) Brandes, 1892, p. 510.—Stiles, 1901, p. 1539.
?1892: *Agamodistomum ophthalmobium* (see pp. 29–34).
?1896: *Dicrocœlium lanceatum* Stiles & Hassall (see below, pp. 28–29).

upon the single observation by von Nordmann (1832, p. ix), which reads as follows:

During the continued investigations on the small animals found in the eyes, I have had opportunity to get on the track of several new and not uninteresting facts. In regard to the human eye, two new cases have now occurred which bear out an earlier expressed conjecture regarding the probability of the more frequent occurrence of entozoa.

During the month of May Professor Jüngken extracted the lenses of two elderly blind women, at which operations I was present. In the first case (*Cataracta lenticularis viridis*) I found in one of the opaque lenses a living *Filaria*, 5½ lines long, in the act of ecdysis, while in the other lens no foreign body was to be discovered.

The second case was more interesting to me and represented the first example of the presence of microscopic trematodes in the human eye, in that there were found eight specimens of monostomes in the lens substance. The animalculæ, which lay in the upper layers of the lens substance, were one-tenth of a line long and moved, although slowly, after they were placed in warm water. The examination was made immediately after the operation. It is worthy of remark that in both cases the lenses were not entirely opaque, the cataracts were in process of formation, and the lens substance was still soft.

There were present at the operation Doctors Jüngken, Becker, Staff Surgeons Braun, Goldschmidt, R. Froriep, Berg, Isensee, the Grecian doctor Fürst Maurocordato, and some other younger medical men.

Partially whitish opacities, which usually have a lancet form, extend from the periphery to the middle of the yellowish or greenish transparent lens, and not infrequently have a resemblance to foreign animal bodies, which can easily deceive the person who is less experienced.[a]

---

[a] "Während der fortgesetzten Untersuchungen über die Augenthierchen habe ich Gelegenheit gehabt, mehreren neuen und nicht ganz uninteressanten Thatsachen auf die Spur zu kommen. In Betreff des Menschenauges, so haben sich jetzt zwei neue Fälle ereignet, die einer früher geäusserten Vermuthung über die Wahrscheinlichkeit des öfteren Vorkommens von Binnenthieren rechtfertigen.

"Im Verlauf des Monats Mai wurde von dem Hrn. Prof. Jüngken hieselbst an zwei älteren erblindeten Frauen die Extraction der Linsen vorgenommen, wobei ich zugegen war. Im ersten Falle (*Cataracta lenticularis viridis*) fand ich in einer der verdunkelten Linsen eine lebende, in der Häutung begriffene, 5½ Lin. lange Filaria, während in der andern Linse kein fremdartiger thierischer Körper entdeckt werden konnte.

"Der zweite Fall war mir interessanter und bot das erste Beispiel vom Vorkommen mikroskopischer Saugwürmer im Menschenauge dar, indem in der Linsensubstanz acht Stück *Monostomen* sich befanden. Die Thierchen lagen in den oberen Schichten der Linsensubstanz, waren $\frac{1}{10}$ Linie lang, und bewegten sich, obschon langsam, nachdem sie in warmes Wasser gelegt worden waren. Die Untersuchung geschah unmittelbar nach der Operation. Bemerkenswerth ist, dass in beiden Fällen die Linsen noch nicht völlig verdunkelt, die Cataracta im Entstehen begriffen, und die Linsensubstanz noch weich waren.

"Bei den Operationen waren zugegen die Herren DD. Jüngken, Becker, der Staabsarzt Braun, Goldschmidt, R. Froriep, Berg, Isensee, der griechische Arzt Fürst Maurocordato, und noch einige jüngere Mediciner.

"Stellenweise weissliche Verdunkelungen, die gewöhnlich eine lanzettförmige Gestalt haben, von der Peripherie zum Mittelpuncte der gelblich oder grünlich durchscheinenden Linse sich strecken, haben nicht selten eine Ähnlichkeit mit fremdartigen thierischen Körpern, welche den weniger Geübten leicht täuschen können."—*von Nordmann, 1832, p. ix.*

It may be noticed, first, that this description is scarcely detailed enough to enable the certain recognition of the parasite. If another case occurred in which monostomes were found in the lens, one would be justified in considering them identical with von Nordmann's form, chiefly on the ground that it would scarcely be possible to prove that they were different. Under these circumstances it need not be thought strange that authors have resorted to more or less speculation in order to interpret this case. It may also be noticed that while later authors have universally attributed the name *Monostoma lentis* to von Nordmann (1832), this author apparently did not use the binomial in question. It would appear, on the contrary, that Gescheidt (1833, p. 421) was the proposer of the name.

Diesing (1850, p. 329) thinks that the worms mentioned by Ammon (1843) as "*Distoma oculi humani*" may be identical with *Monostoma lentis*, an opinion more or less concurred in by Weinland (1859, p. 80), Cobbold (1876, p. 211), and others. While this view can not be designated as impossible, it should be recalled that the figures and description of "*D. oculi humani*" (see p. 29) distinctly prove the presence of two suckers; hence, if Diesing is correct, *Monostoma lentis* would have to be considered a distome [*Agamodistomum*], as Küchenmeister (1855, pp. 180–182) has already pointed out, and not "*Distoma oculi humani*," a member of the genus *Monostoma*. Against considering *Monostoma lentis* an *Agamodistomum*, the point may be advanced, as already recognized by Leuckart (1863), that Nordmann had the opportunity of examining the fresh material, and since he was an exceedingly careful observer, it would not appear unreasonable to assume that he would have discovered the ventral acetabulum had one been present. Too much weight, however, should not be attached to this argument, since it has not infrequently occurred that ventral acetabula have escaped the attention of even careful observers. Küchenmeister (1855, pp. 180–182) endeavored to settle the questions involved by a reexamination of the original specimens, but this, unfortunately, was not possible, since they could not be found. He suggests the possibility that the organism in reality represents a young *Cysticercus cellulosae*, and refers to the possibility of mistaking young specimens of *Cysticercus pisiformis*, of the rabbit, for trematodes. *Monostoma leporis* has, as a matter of fact, been shown by Railliet (1890) to be *Cysticercus pisiformis*. Later (1882, p. 285) Küchenmeister gave up this idea and he looked upon the parasite as resulting from a proliferating redia, the capsule of which might have escaped the attention of Jüngken. Leuckart (1863, pp. 526, 633–634) is inclined to doubt Küchenmeister's view of the cysticercal nature of *Monostoma lentis*. He says:[a]

My observations on the development of this parasite [*Cysticercus cellulosæ*] are only slightly favorable to this hypothesis. Not only that the young bladder worms origi-

[a] "Meine Beobachtungen über die Entwicklung dieses Schmarotzers sind dieser Hypothese nur wenig günstig. Nicht blos, dass die jungen Finnen anfangs eine

nally have a globular form, therefore could indeed with difficulty be mistaken for a trematode, but also the circumstance is here to be considered that Nordmann's worms measured only 0.3 mm. (one-tenth of a line), accordingly they were much too small, as cysticerci, to have a head primordium. As I have convinced myself, the primordium of the head of *Cysticercus cellulosæ*, like *C. taniæ mediocanellatæ*, forms when the bladder worm is about 0.8 mm. long, accordingly in animals which are twice as large as the worms seen by von Nordmann.

This rather keen reasoning by Leuckart deserves full attention; at the same time it may be recalled that Nordmann did not state that the worms were not globular; many trematodes are, in fact, nearly globular.

Moquin-Tandon (1860, p. 349; 1861, p. 375) changes the name to *Festucaria lentis*, and thinks the parasite might be mistaken for "*Fasciola oculis.*" (See p. 29.)

R. Blanchard (1888, pp. 542–543) does not consider the presence of monostomes in the human eye an impossibility; in fact, certain species are able to live in mammals, and *Monostoma Setteni* has been reported by Numan in the horse's eye, while *Monostoma constrictum* was observed by Diesing in the eye of the bream (*Abramis brama*). It may, however, be observed that Blanchard and Railliet (1891) afterwards showed *Monostoma Setteni* to be a larval dipteron.

One other view advanced as to the parasite under discussion is that it may possibly be an erratic trematode, perhaps a young *Fasciola hepatica* or a young *Dicrocoelium lanceatum*. Such a possibility is mentioned, although not always without some reserve, by several authors—Blanchard (1895), Moniez (1896), Stiles (1898), and others.

From the above review it will be clearly seen that *Monostoma lentis* is a problematic organism. Furthermore, it may be safely assumed that the specimens were immature.

Nomenclature.—In order to aid in clearing up the helminthological nomenclature, Stossich has proposed to transfer the agamic distomes to the collective group *Agamodistomum*, while Brandes has proposed the names *Monostomulum* and *Amphistomulum* for agamic monostomes and amphistomes. It is quite clear that the form now under discussion should be transferred either to *Monostomulum* or to *Agamodistomum*, and from the meager evidence at hand *Monostomulum* is to be preferred.

The oldest certain specific name of this parasite is *lentis*, which is available, at date of writing, for all the generic names (*Monostoma*, *Monostomulum*, *Distoma*, *Agamodistomum*) which come into consideration, hence the valid name at present is *Monostomulum lentis*. Should it afterwards be proved that this parasite is identical with *Dicrocoelium*

---

kugelrunde Form haben, also wohl schwerlich mit einem Trematoden verwechselt werden können, auch der Umstand ist hier zu bedenken, dass die Nordmann'schen Würmer nur 0,3 mm. ($\frac{1}{10}'''$) massen, also viel zu klein waren, um (als Cysticercen) bereits einen Kopfzapfen zu trägen. Wie ich mich nachträglich überzeugt habe, bildet sich die Anlage des Kopfzapfens bei dem *Cyst. cellulosæ*, ganz wie bei *Cyst. taniæ mediocanellatæ*, wenn der Blasenkörper etwa 0,8 mm. misst, also bei Thieren, die mehr als doppelt so gross sind, wie die von v. Nordmann gesehenen Würmer."—*Leuckart, 1863, p. 634.*

Explanation of Plate III.

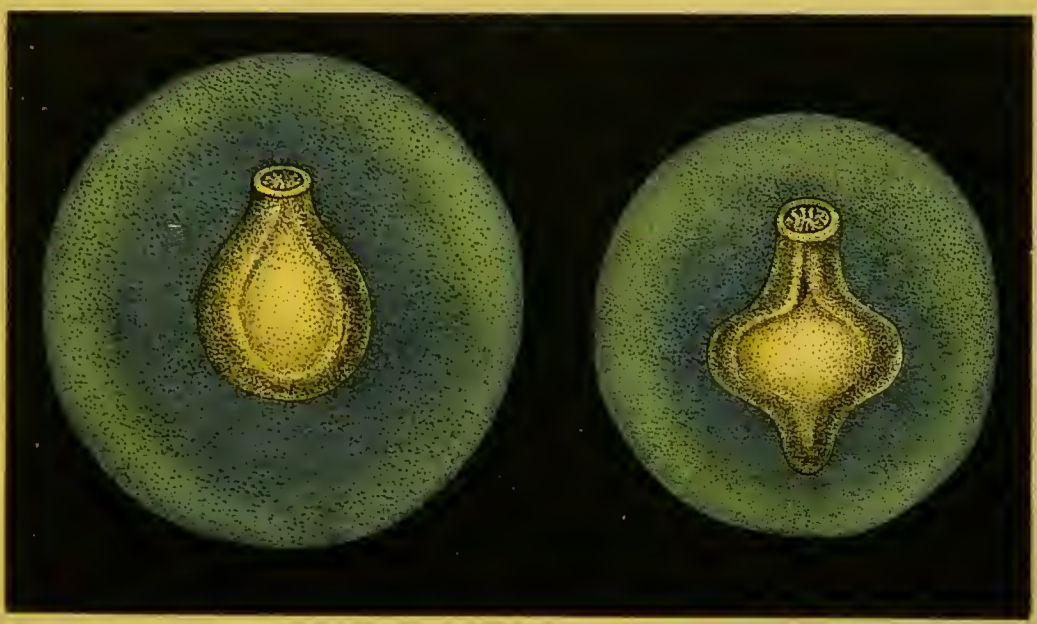
Fig. 2. Ventral view of *Agamodistomum ophthalmobium*. (After von Ammon, 1838, pl. 12, fig. 24.)

Fig. 3. "Dorsal" (lateral?) view of same. (After von Ammon, 1838, pl. 12, fig. 25.)

Figs. 4, 5. Two other views of same in different stages of contraction. (After von Ammon, 1841, pl. 14, figs. 19, 20.)

Note that in fig. 2, published in 1838, a ventral acetabulum is distinct; in figs. 4 and 5, published in 1841, no ventral acetabulum is evident.

2 3



4 5

Haines, del. A Hoen & Co., Lithocaustic

DORSAL AND VENTRAL VIEWS OF AGAMODISTOMUM OPHTHALMOBIUM.

lanceatum or any other form (such a contingency seems extremely remote), the question of nomenclature must be decided upon according to the names involved.

Collective Group Agamodistomum[a] Stossich, 1892.

This is an artificial collective genus, in which are placed all specimens of distomes which have not yet reached a stage of development permitting the recognition of their true generic position.

The Eye Distome (Agamodistomum ophthalmobium[b] (Diesing, 1850) Stossich, 1892), of Man.

[Plate III, figures 2 to 5.]

Diagnosis.—*Agamodistomum:* Body ovate-lanceolate, variable, one-fourth to one-half line long, one-sixth of a line broad. Mouth terminal to subterminal, orbicular. Acetabulum one-third larger than oral sucker, subcentral, with circular aperture.

Habitat.—Between crystalline lens and its capsule, in eye of man (*Homo sapiens*), in Dresden.

This parasite has been found but once, and all the numerous references to it in zoological and medical literature are based upon the

---

[a] Synonymy and Bibliography.

1892: *Agamodistomum* Stossich, 1892, p. 4.—Idem, 1895, pp. 228–229.—Stiles & Hassall, 1898, pp. 82, 96.—Stiles, 1898, pp. 22, 28, 29.—Idem, 1901, p. 1539.
1892: *Distomulum* Brandes, 1892, p. 510.
1898: *Agamodistoma* Stossich, 1898, pp. 58–59.

[b] Synonymy and Bibliography.

1833: "Distomen" Ammon, 1833, pp. 74–75.
1833: *Distoma oculi humani* Gescheidt, 1833, pp. 434–435.—Eiss, 1838, pp. 22–23.—Ammon, 1838, p. 37, pl. 12, figs. 24–25.—Idem, 1841, p. 72, pl. 14, figs. 19–20.—Rayer, 1843, pp. 114, 116–117, 149.—Küchenmeister & Zürn, 1881, pp. 328, 329, pl. 7, fig. 13.—Bonis, 1882, p. 180.—R. Blanchard, 1888, pp. 630–631.—Braun, 1895, pp. 144–145.—Moniez, 1896, pp. 152–153.
1850: *Distomum ophthalmobium* Diesing, 1850, p. 334 [=*Distoma oculi humani* renamed].—Idem, 1858, p. 333.—Küchenmeister, 1855, pp. 222–223, pl. 4, figs. 13–15.—Idem, 1858, pp. 287–288, pl. 4, figs. 13–15.—Leuckart, 1863, pp. 610–613, fig. 205.—Idem, 1889, p. 440, fig. 191.—Idem, 1894, pp. 441–445.—Wagner, 1876, p. 121.—Davaine, 1877, pp. lxxix, 820, 822.—Linstow, 1878, p. 3.—Vogt, 1878, pp. 10, 13.—Braun, 1893, p. 870.—Blanchard, 1895, p. 733.—Schneidemühl, 1896, p. 302.—Stiles, 1898, p. 48.
1855: *Distoma ophthalmobium* (Diesing, 1850) Küchenmeister, 1855, p. 181.—Idem, 1858, p. 246.—Günther, 1858, pp. 205, 209.—Cobbold, 1860, p. 6.—Idem, 1864, pp. 191–192, fig. 41 [in part].—Idem, 1866, p. 7.—Idem, 1876, p. 211.—Idem, 1879, p. 36, fig. 5.—Moquin-Tandon, 1861, p. 373.—Küchenmeister & Zürn, 1881, pp. 328–329, pl. 8, fig. 12.—Braun, 1883, pp. 64–65.—Mosler & Peiper, 1894, p. 177.—Kholodkovski, 1898, pp. 26, 32, 34, pl. 11, fig. 28.
1859: *Dicrocœlium oculi humani* (Diesing, 1850) Weinland, 1858, p. 86.—Idem, 1859, p. 281.
1860: "*Distoma oculare* Nordmann" of Moquin-Tandon, 1860, p. 347.
1860: *Fasciola ocularis* Moquin-Tandon, 1860, p. 347 (*Distoma ophthalmobium* renamed).
1861: *Fasciola oculis* Moquin-Tandon, 1861, p. 375 (for *F. ocularis*).
1882: *Distoma ocular* de Bonis, 1882, p. 180.
1892: *Agamodistomum ophthalmobium* (Diesing, 1850) Stossich, 1892, p. 33.
?1896: *Dicrocoelium lanceatum* Stiles & Hassall, 1896, p. 158.
1896: "*Distom. okuli humani* Ammon" of Schneidemühl, 1896, p. 302.

observations made by von Ammon and Gescheidt. Ammon's original account of the patient reads as follows:[a]

CONGENITAL HARD AND SOFT CATARACT WITH PARTIAL OPACITY OF THE CAPSULE.

In July, 1832, Professor Hasse, director of the Dresden Lying-in Institute, had the kindness to bring to my knowledge the fact that a child with cataracts on both eyes had been born in the institution which is under his direction. The examination of the child which was permitted me, through the kindness of Professor Hasse, shortly after delivery, showed a gray-blue colored iris on both eyes; the eye had the peculiarity that about a line from the inner border of the pupilla there was an irregular circle formed of numerous small white points. This peculiar ring reminded one very much of the first formation of the bony ring (composed of numerous white regular osseous points) on the eye of birds. On the left eye the cataract was peculiar in so far that in its middle the usual three-pronged cleft belonging to the cataract was here present. Around this somewhat dark cleft the lens was very cloudy. On the right there was a soft cataract, not to be mistaken, through the anterior very slightly opaque wall of the lens capsule. Artificial dilation of the pupils, repeatedly practiced, revealed nothing except the above-described condition, in spite of the more extensive view of the opaque lens. A rolling motion [nystagmus] of the eyeball was not present, but the motion was entirely natural; the eyeballs did not lie at all deep in the orbits. Now and then the child opened its eyelids very wide, just as if it

---

[a] CATARACTA CONGENITA DURA ET MOLLIS CUM PARTIALI CAPSULÆ SUFFUSIONE.

"Im Juli 1832 hatte Herr Professor Haase, Direktor des Dresdner Gebärinstituts, die Güte, mich davon in Kenntniss zu setzen, dass in der seiner Leitung untergebenen Anstalt ein Kind mit Staaren auf beiden Augen geboren worden sey. Die durch die Gefälligkeit des Herrn Professor Haase mir bald nach der Geburt gestattete wiederholte Untersuchung des Kindes zeigte eine grau-blau gefärbte Iris auf beiden Augen, welche die Eigenthümlichkeit hatten, dass ohngefähr eine Linie von dem innern Pupillarrand entfernt ein regelmässiger, aus lauter kleinen weissen Punkten gebildeter Kreis sich befand. Dieser eigenthümliche Ring erinnerte sehr an die erste Bildung des Knochenringes (aus lauter kleinen weissen regelmässigen Knochenpunkten bestehend) am Augen der Vögel. Auf dem linken Auge war die Cataracta in so fern eigenthümlich, als sich in ihrer Mitte hier die der Cataracta dura angehörige eigenthümliche dreizackige Spaltung vorfand. Um diese etwas dunkle Spaltung war die Linse sehr getrübt. Auf dem rechten Auge war eine weiche Cataracta, durch die sehr wenig getrübt vordere Linsenkapselwand nicht zu verkennen. Künstliche Erweiterung der Pupillen zu wiederholten Malen gemacht, liess, ausser den angeführten Bemerkungen, trotz des grössern Ueberblicks über die verdunkelten Linsen nichts wahrnehmen. Eine rollende Bewegnng der Augäpfel war nicht vorhanden, sondern es ging dieselbe ganz naturgemäss von Statten; die Bulbi lagen durchaus nicht tief in den Orbitis. Dann und wann öffnete das Kind die Augenlider sehr weit, gleichsam als wolle es von der [p. 75] vorhandenen, aber durch die verdunkelten Linsen verdeckten Sehkraft Gebrauch machen.

"Das Kind war von der Mutter, die dasselbe ausserehelich geboren hatte, sehr vernachlässigt worden, so dass es sehr bald in eine Atrophia meseraica verfiel, die es im November 1832, tödtete. Eine genaue anatomische Untersuchung der aus den Orbitis genommenen Auge zeigte Folgendes:

"Rechtes Auge. · Die Form des Bulbus war normal, eben so Farbe und Consistenz der Sclerotica und Cornea. Der Glaskörper zeigte nichts Krankhaftes; die Netzhaut war ziemlich dick, ohne Foramen centrale, wohl aber mit starker Centralfalte versehen, die nach oben eine eigenthümliche Querfalte hatte, so dass sich hier die Gestalt eines Kreuzes bildete. Etwas gelblich war die Netzhautfalte gefärbt, jedoch konnte der gelbe Fleck bestimmt nicht unterschieden werden. In Spiritus vini gelegt,

wanted to make use of the power of sight which was present but concealed by the opaque lenses.

The child, which was illegitimate, was very much neglected by its mother, so that it soon fell into an atrophia meseraica, which killed it in November, 1832. A detailed anatomical examination of the excised eyes showed the following:

Right eye.—The form of the bulbus was normal, as were also the color and consistency of the sclerotica and the cornea. The crystalline lens showed no disease; the retina was quite thick, without foramen centrale, but provided, however, with a thick central fold, which had a peculiar transverse fold near the top, so that the figure of a cross was here formed. The retinal fold was colored somewhat yellowish; still the yellow spot could not be clearly distinguished. Placed in spirits of wine the retina appeared still thicker; the macula badia on the choroidea was present, but not colored very dark, and the pigment in the background of the choroidea around the entrance of the optic nerve was colored very dark. The lens and lens capsule, when examined under a hand lens, showed here and there on the anterior surface of the capsule some clouded places; through the capsule were seen large opaque portions of the lens, especially in the middle point; on the lateral portions the substance of the lens was normal in hardness and transparency; here the capsule was light and clear. Dr. Gescheidt, who examined the lens substance under the microscope for the entozoa [see above, p. 25, *Monostomulum lentis*], discovered by Dr. von Nordmann in Odessa in opaque human lenses, found four distomes, of the presence of which I also convinced myself on autopsy. Dr. Gescheidt did not risk a determination of the species, because of the newness of the examination. The lens of the left eye was also opaque, while the lens capsule of the same did not at first show any opacities; later, however, after it had lain twenty-four hours in water, it became somewhat softer, and it clouded; the middle of the lens substance, which exhibited the normal cleavage and which was transparent and normal on the borders, had a peculiar triangular nucleus, which moved here and there in the lens substance, was opaque and almost horn-like, and approached the calcareous-like concretions as to color and density. On the whole, the lens of the left eye was smaller than that of the right eye. The other parts of the bulbus had the same formation [Beschaffenheit] as those of the right eye.

---

erschien die Netzhaut noch dicker; die Macula badia auf der Choroidea war vorhanden, jedoch nicht sehr dunkel gefärbt, und überhaupt war das Pigment im Hintergrunde der Choroidea um den Eintritt des Sehnerven herum nichts weniger als sehr dunkel gefärbt. Die Linse sammt Linsenkapsel unter der Lupe untersucht, zeigte an der vordern Fläche der letztern hier und dort einige trübe Stellen; durch die Linsenkapsel hindurch sah man grosse Theile der Linse, vorzüglich im Mittelpunkt, undurchsichtig; an den Seitentheilen war die Linsensubstanz in Betreff der Härte und Durchsichtigkeit normal; hier war auch die Kapsel hell und klar. Herr Dr. Gescheidt, welcher die Linsensubstanz, Betreff der von Dr. v. Nordmann in Odessa, in verdunkelten menschlichen Linsen entdeckten Entozoen unter dem Mikroskope untersuchte, fand vier [p. 76] Distomen, von deren Gegenwart ich mich durch Autopsie ebenfalls überzeugte. Die Species zu bestimmen, wagte Herr Dr. Gescheidt bei der Neuheit der Untersuchung nicht. Die Linse des linken Auges war ebenfalls verdunkelt, während die Linsenkapsel desselben anfangs keine dunkeln Stellen zeigte, später jedoch, nachdem sie vier und zwanzig Stunden im Wasser gelegen hatte, sich etwas auflockerte und verdunkelte; die Mitte der Linsensubstanz, welche jene eigenthümliche Spaltung zeigte und an den Rändern ziemlich durchsichtig und normal war, hatte einen eigenthümlicher dreieckigen Kern, der sich in der Linsensubstanz hin und her schob, undurchsichtig und fast hornartig war, und sich der kalkartigen Concretion in Betreff der Farbe und Dichtigkeit näherte. Im Ganzen war die Linse des linken Auges offenbar kleiner als die des recten Auges. Die übrigen Theile des Bulbus hatten dieselbe Beschaffenheit wie die des recten Auges."—*Ammon, 1833, pp. 74–76.*

Gescheidt[a] (1833, pp. 434–435) described the parasites in question as follows:

Distoma oculi humani.—After I had examined several human eyes in vain for entozoa (among which four presented not inconsiderable organic changes), I at last succeeded in finding distomes in the lens capsule of a child. The child was 5 months old, born with lenticular cataract with partial opacity of the capsule, and died of atrophia meseraica. The observations on the living child and the results of the dissection of the eye, made thirty-six hours after death, which Professor von Ammon conducted in my presence, are found in the article on congenital cataract communicated by him in the first number of this volume [see above, pp. 30–31], and I have therefore to add here only the facts bearing upon the distomes.

There were four of these in number, between the lens and the lens capsule, on the anterior wall of which the location of the animalculæ revealed itself to the naked eye through some clouded places. The animalculæ, one-fourth to one-half line long, were surrounded by an opaque, veil-like, white mass, and were seen in different positions. One specimen, which was free, without the veil-like surrounding mass, lay between the lens and the lens capsule, appeared in extended position, the suckers turned toward the under surface of the capsule wall, and it exhibited no movements. Two others which had retracted the caudal portion, exhibited therefore a form not unlike a phial, and gave slight evidences of life in that they retracted and extended the caudal portion. Once one of them assumed more the form of a cross with rounded arms, in that it retracted the middle portion of the body, while it stretched somewhat the head and tail ends, so that one could consider the head end as the upper arm, and the tail end as the lower arm, and the contracted middle portion as the lateral arms. The fourth specimen lay stretched, but lateral, and was motionless. In its stretched position the animalcula showed a lanceolate shape, the breadth being to the length as 1 to 3. The coloring was white. The anterior sucker, one-third smaller than the ventral sucker, appeared semicircular, provided with scarcely appreciably raised margins and with radiate fibers. The pharyngeal bulb was short and narrow, and merged quickly into the intestinal canal, which was of nearly the same breadth; the intestine branched, fork-like, somewhat anterior of the ventral sucker, extended down at each side of the latter toward the tail end, and here, covered by the ovaries, could not be followed farther. Of the organization of the ovaries there was also nothing definite to be recognized; only in one specimen I believed I could note the somewhat transverse position of the cotyledons. Professor von Ammon and my friend the practicing physician, Münch, were present at the examination.

---

[a] "*Distoma oculi humani.*—Nachdem ich schon mehre Menschenaugen, unter denen 4 mit nicht unbedeutenden organischen Veränderungen sich befanden, in Bezug auf Entozoen vergebens untersucht hatte, gelang es mir endlich bei einem Kinde in der Linsenkapsel Distomen aufzufinden. Das Kind war fünf Monat alt, mit Cataracta lenticularis cum partiali capsulæ suffusione geboren und starb an Atrophia meseraica. Die Beobachtungen am lebenden Kinde und die Resultate der 36 Stunden nach dem Tode an den Augen angestellten Section, die Prof. v. Ammon in meinem Beiseyn veranstaltete, findet man in dem von diesem im ersten Hefte dieses Bandes mitgetheilten Aufsatze über die angeborne Cataract (S. 74–76), und ich habe daher hier nur das die Distomen specielle Betreffende hinzu zu fügen.

"Es befanden sich dieselben, 4 Stück an der Zahl, zwischen der Linse und Linsenkapsel, an deren vorderer Wand der Aufenthaltsort der Thierchen sich schon mit dem blosen Auge durch einige trübe Stellen zu erkennen gab. Die Thierchen, ¼ bis ½ Linie lang, waren mit einer undurchsichtigen, schleierartigen, weissen Masse umgeben und zeigten sich in verschiedenen Stellungen. Das eine Exemplar, welches mehr frei, ohne schleierartige Umgebung, zwischen der Linse und Linsenkapsel lag,

Some years later, Ammon (1838, p. 37; 1841, p. 72) gave four illustrations of this parasite, which are here reproduced. His explanation of the figures simply states:

Fig. 24. Figure of a *Distoma oculi humani*, anterior view, and in fig. 25, a posterior view.

Figs. 19, 20. Figures of *Distoma oculi humani* from the lens capsule of a congenital cataract. (Compare Gescheidt, Die Entozoen des Auges. Zeitschrift für Ophthalmologie, v. 3 (4).)

From the above description it is clear that an exact specific or even generic determination of the parasite is impossible. That it was a distome rather than a monostome is perfectly evident from fig. 2. That it may be a young stage of one of the liver flukes which had accidentally wandered to the eye must be admitted, but whether it belongs to *Fasciola hepatica*, *Dicrocœlium lanceatum*, or *Opisthorchis felineus*—all three of which occur in Germany, is a question which can not be definitely solved. Braun (1895, p. 144) inclines to the view that it is a *Dicrocœlium lanceatum*.

How the infection took place in this young child is a mystery. If the parasites were present in the fetus, the case would appear almost, though not absolutely, isolated in helminthology; furthermore, in such an event it is difficult to understand how they lived so long. This view, which is not excluded, presupposes that the mother became infected with liver flukes, which wandered to the fetus instead of to their natural habitat. That they entered the eye directly from water used in washing seems practically excluded. Another possible supposition is that the child swallowed the cercarian stage of four distomes,

---

erschien in gestreckter Lage die Saugmündungen nach der untern Fläche der Kapselwand zugekehrt und äusserte keine Bewegung. Zwei andere hatten den Schwanztheil eingezogen [p. 435], zeigten daher eine den Phiolen nicht unähnliche Gestalt, und gaben, indem sie den Schwanztheil langsam ein- und auszogen, noch schwache Lebensäusserungen zu erkennen. Einmal nahm das Eine derselben mehr die Form eines mit abgerundeten Schenkeln versehenen Kreuzes an, indem es den mittlern Körpertheil zusammenzog, während es das Kopf- und Schwanzende etwas streckte, so dass man den Kopftheil als den obern Schenkel des Kreuzes, das Schwanzende als den untern, und den zusammengezogenen mittlern Theil als die seitlichen Schenkel betrachten konnte. Das 4te Exemplar lag gestreckt, aber seitlich, und war bewegungslos. In der gestreckten Lage zeigte das Thierchen eine lanzettförmige Gestalt und verhielt sich mit seiner Breite zur Länge wie 1–3. Die Färbung war weiss. Der vordere Saugnapf, um $\frac{1}{3}$ kleiner als der mittlere, erschien halbkreisrund mit kaum merklichen wulstigen Rändern und strahlenförmigen Fassern versehen. Der Schlundkopf war kurz und enge und ging schnell in den fast gleichweiten Darmkanal über, der sich etwas über den mittlern Saugnapf gabelförmig spaltete, zu beiden Seiten desselben nach dem Schwanzende herunter lief, und hier, von den Ovarien bedeckt, nicht weiter verfolgt werden konnte. Von der Organisation der Ovarien war ebenfalls nichts Bestimmtes wahrzunehmen; nur bei einem Individuum glaubte ich die etwas unregelmässige transverselle Lagerung der Cotyledonen bemerken zu können. Bei dieser Untersuchung war der Herr Prof. v. Ammon und mein Freund, der pract. Arzt, Münch, zugegen."—*Gescheidt, 1833, pp. 434–435.*

or possibly in a redia, as suggested by Küchenmeister & Zürn (1881), either in water or in contaminated food.

Diesing (1850, p. 334) renamed this parasite binomially as *Distomum ophthalmobium*, giving it the following diagnosis:

> Body ovate-lanceolate, depressed, variable. Neck short, subcylindrical. Mouth terminal, orbicular. Acetabulum one-third larger than mouth, subcentral, with circular aperture. Length, one-fourth to one-half line; breadth, one-sixth line.[a]

Küchenmeister (1855, pp. 222–223) endeavored to find the original preparations in the pathological collection of the Academy of Dresden, but was unable to do so. Cobbold's (1864) view that this parasite is identical with *Monostomulum lentis* has been referred to above (see p. 25).

Leuckart (1863, pp. 610–613) is not inclined to assume that the parasites entered through the cornea or sclera, and suggests the possibility of their representing young specimens of *Dicrocoelium lanceatum* or *Fasciola hepatica*—possibly specimens which wandered from the mother before the child was born, and thus caused the congenital cataract.

Küchenmeister & Zürn (1881, pp. 328–329), in reverting to the subject, think that the slimy mass described as surrounding the parasites indicates the formation of a capsule. They further suggest that the parasites arose from infection by a redia.

Nomenclature.—Systematically, helminthologists would now place this worm in the collective group *Agamodistomum*. The name *oculi humani* is not available as a specific name, since the combination *Distoma oculi humani* is not binomial. The correct technical name for this problematic worm is, therefore, *Agamodistomum ophthalmobium*.

SUMMARY.

Although the zoological data concerning these two worms are far from complete, they are sufficiently detailed to demand their acceptance as actual cases of parasitism. There is no reason to assume that these parasites are normal inhabitants of the eye. On the contrary, everything points to the view that they represent instances of abnormal positions for parasites which normally inhabit some other part of the body, similar to the cases reported of the presence of bladder worms (*Cysticercus cellulosae*) in the eye. Zoologically, it seems highly probable that at least the second case (*Agamodistomum*) represents one of the liver flukes found in man and various domesticated animals, and the cases here reviewed indicate that we may expect to find other similar cases in both man and the domesticated animals.

Regarding their pathogenic nature, a doubt can scarcely arise, and a comparison with similar cases of parasitism by trematodes in the eyes

---

[a] "*Corpus* ovato lanceolatum depressum, variabile. *Collum* breve subcylindricum. *Os* terminale orbiculare. *Acetabulum* ore ⅓ majus subcentrale apertura circulari. Longit., ¼–½‴; latit., ⅛‴."

of certain fish, as reported by von Nordmann, fully supports the view that such parasites may occasionally cause diseased conditions in the eye.

Bibliography.—The general works referred to in this article may be recognized from the authors' names and dates; in case of doubt, consult the Index-Catalogue of the Surgeon General's Library, or the card catalogue of the Zoological Laboratory, Bureau of Animal Industry, which is now being prepared for press as "Index-Catalogue of Medical and Veterinary Zoology." The titles of the articles in which the original observations were published are:

AMMON, F. A.

1833.—Die angeborne Cataracta in pathologisch-anatomischer, in pathogenetischer und operativer Hinsicht < Ztschr. f. d. Ophth., Dresden, v. 3 (1), pp. 70–99.

1838.—Klinische Darstellungen der Krankheiten und Bildungsfehler des menschlichen Auges der Augenlider und der Thränenwerkzeuge nach eigenen Beobachtungen und Untersuchungen. 1. Theil. viii + 69 pp., 23 pls. fol. Berlin.

1841.—Idem. 3. Theil. viii + 90 pp., 20 pls. fol. Berlin.

GESCHEIDT.

1833.—Die Entozoen des Auges < Ztschr. f. d. Ophth., Dresden, v. 3 (4), pp. 405–462.

VON NORDMANN, ALEXANDER.

1832.—Mikrographische Beiträge zur Naturgeschichte der wirbellosen Thiere. 2. Heft, xviii + 150 pp., 10 pls. 4°. Berlin.

A CASE OF VINEGAR EEL (ANGUILLULA ACETI) INFECTION IN THE HUMAN BLADDER.

By CH. WARDELL STILES, PH. D.,
Pathologist of Bureau of Animal Industry,

AND

W. ASHBY FRANKLAND, M. D.

[Plate IV, figures 6–13.]

In November, 1900, one of us was called to attend a young married woman professionally. During an examination of the urine, some minute worms were found which proved to be rhabditiform embryos. In order to exclude all possibility of accidental infection of the urine from external sources, a specimen was then taken with the catheter. In this sample numerous worms of all stages were found, and these were eventually determined as *Anguillula aceti.*

This species is the ordinary vinegar worm. It belongs to the nematodes, family Anguillulidæ, which appears to have been established by Gervais & van Beneden in 1859. The most complete diagnosis of it yet written appeared in Bastian's important essay, published in 1866, and reads as follows:

FAMILY ANGUILLULIDÆ GERVAIS & VAN BENEDEN.

FAMILY DIAGNOSIS.—*Nematoda:* "Free nematoids.—Body cylindrical, tapering more or less at either extremity. Integument transparent, striated, or plain; naked, or provided with papillæ or setæ; traversed by capillary pores; shed and renewed at intervals. Caudal sucker mostly present. Glandular system well developed; often single excretory organ in anterior part of ventral region. Lateral lines existing as cellular canals communicating with the exterior, with or without a central channel; in others replaced by distinct vessels. Median lines indistinct. Nervous system, none. Ocelli, when present, aggregations of reddish pigment on anterior part of esophagus, with or without transparent lens-like bodies. Generative organs: Female, composed of double symmetrical uteri and short reflexed ovarian tubes, with vagina near center of body; vagina occasionally more posterior, with posterior uterine segment and ovary undeveloped; ova few, large; male, consisting of an almost simple seminal tube, and two equal horny spicules, either alone or with one or more accessory pieces."

Zoologists recognized a number of genera as belonging to the Anguillulidæ. The type genus (to which the species here considered belongs) is characterized by Bastian as follows:

ANGUILLULA EHRENBERG (*Vibrio* MÜLLER; *Ascaris* GOEZE; *Rhabditis* DUJARDIN).

GENERIC DIAGNOSIS.—*Anguillulidæ:* "Body long, narrow and tapering at extremities. Caudal sucker absent. Integument thin, presenting neither transverse nor longitudinal markings; setæ, none (?); papillæ, none (?) [present—C. W. S.]. Pharyngeal cavity very minute. Esophagus cylindrical, with rounded swelling posteriorly containing a simple horny valvular apparatus. Intestine sparingly covered with large colorless granules, presenting no appearance of tessellation; distinct cells not recognizable. Vulva posterior to the middle of body. Uterus unsymmetrical. Oviparous or viviparous. Spicules long, narrow, curved. Accessory piece single, posterior, somewhat fan-shaped. Ventral gland wanting. Floating gland cells abundant. Lateral canals not recognizable. Movements active."

As specific description of the worm now under consideration, Bastian gives the following characters:

ANGUILLULA ACETI.

SPECIFIC DIAGNOSIS.—*Anguillula:* "Female (size very variable); length, one-thirteenth inch; breadth, one five-hundred-and-fifty-fifth inch. External characters: Body white; much obscured by colorless granules within integument; long and narrow, tapering very much posteriorly, and terminating in a long pointed extremity. Head rounded; unarmed. Integument thin, showing no striæ. Pharyngeal cavity very minute; cup-shaped. Esophagus one-ninth of total length, having a rounded swelling at termination containing valvular apparatus. Intestine covered with coarse, colorless granules; no sort of tessellation. Anus one-eightieth inch from posterior extremity. Vulva somewhat posterior to middle of body. Uterus unsymmetrical. Small floating gland cells numerous in cavity of body.

"Male: Length, one twenty-first inch; breadth, one eight-hundred-and-fiftieth inch. Esophagus one-seventh of total length. Anus one one-hundred-and-thirty-third inch from posterior extremity. Spicules narrow, having a double curve one seven-hundred-and-fourteenth inch long. Accessory piece about one-third as long as spicules; rather thick externally, but expanding inwards into a thinner fan-shaped portion."

Explanation of Plate IV.

Fig. 6. Lateral view of male specimen of the vinegar eel (*Anguillula aceti*) from the human bladder. Greatly enlarged. Original.

Fig. 7. Caudal portion of same species: *i*, intestine; *t*, testicle; *sp*, spicule; *a. p.*, accessory piece. Greatly enlarged. Original.

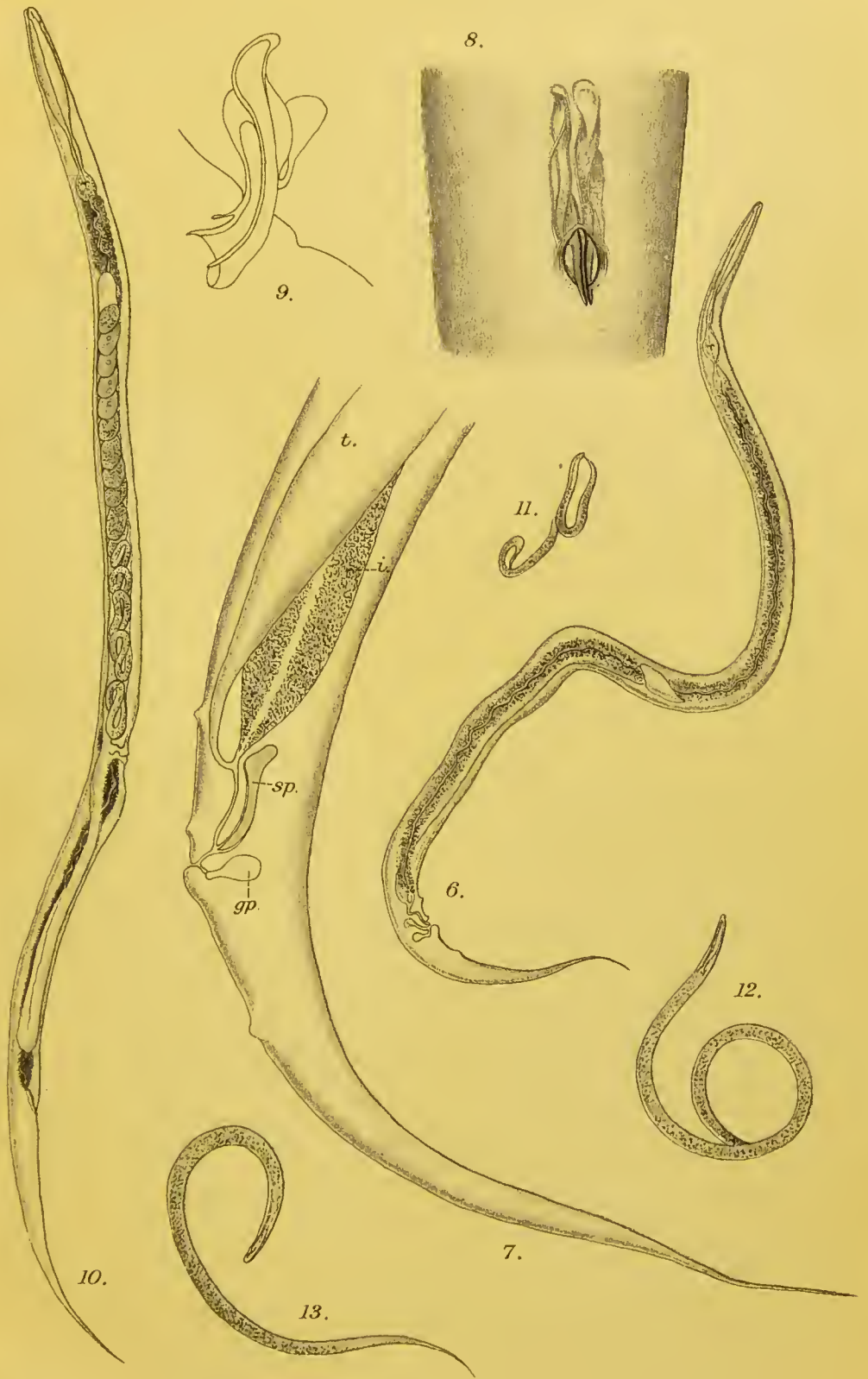
Fig. 8. Ventral view of cloacal opening of same, showing partially extruded spicules. Greatly enlarged. Original.

Fig. 9. Outline lateral view of partially extruded spicules. Greatly enlarged. Original.

Fig. 10. Gravid female vinegar eel from the human bladder. Embryos and eggs are present only in the anterior horn of the uterus. Greatly enlarged. Original.

Fig. 11. Young embryos of same. Greatly enlarged. Original.

Figs. 12, 13. Somewhat older embryos. Greatly enlarged. Original. The esophagus is evident in both specimens, and fig. 13 shows in addition a trace of the rectum.



Haines, del.

A. Hoen & Co. Lithocaustic

VINEGAR EEL (ANGUILLULA ACETI)

We have quoted the above, as representing the work of a standard author who has studied not only this, but also allied forms. Many of the published references to this worm are exceedingly indefinite, the characters quoted being too general and the figures too inexact to be satisfactory. Still, while the possibility that the forms reported from vinegar represent more than one species is by no means excluded, no facts at present accessible seem to compel the recognition of any species except *Anguillula aceti*.[a]

The worms observed in our case agree essentially with the characters noted by Bastian, and we have obtained also worms from vinegar here in Washington which we are unable to distinguish morphologically with certainty from the nematodes taken from the bladder of the patient.

The structure of the parasites may easily be seen from figures 6 to 13 accompanying this paper.

The males are constantly somewhat smaller than the females. No transverse striation could be discovered on the cuticle. Both sexes agree in having an elongated body of nearly uniform diameter tapering but slightly toward the mouth, while the tail is gradually attenuated from the anus caudad, its end being drawn out into a sharp point.

The intestinal tract presents the characteristics of the family, being divided into an esophagus, a stomach intestine, and a rectum. The esophagus presents three distinct divisions—(1) an anterior elongated portion which is quite thick, (2) followed by a shorter middle portion of smaller diameter, and (3) a so-called esophageal bulb provided with a tridentate armature which is characteristic of the rhabditiform worms.

The stomach intestine is a simple tubular structure extending from the posterior portion of the esophageal bulb to the anterior end of the rectum. It possesses a distinct lumen, and during life its tissue is so crowded with minute globules as to interfere materially with a careful study of details.

The rectum is short and narrow, extending from the posterior end of the stomach intestine to the anus, which is situated in the posterior portion of the body.

In the female the rectum is simple. In the male it receives the products of the testicle, thus forming a genital cloaca, while near the anus it also receives the spicules.

Males.—The males are usually about 1.35 to 1.45 mm. long by 24 to 28 μ in diameter. Taking a specimen which measured 1.04 mm. from mouth to anus as basis, the following measurements may be noted: Distance from anterior extremity to the teeth of the esophageal bulb, 132 μ; anterior portion of esophagus, 104 μ long by 12 μ in

[a] We use this name in its ordinarily accepted sense, without having consulted the entire literature to see whether the name is valid under the International Code.

diameter; middle portion of the esophagus, 12 to 15 μ long by scarcely 8 μ in diameter; esophageal bulb, 16 to 18 μ long by 18 μ in diameter; dorsoventral diameter about middle of the worm, 24 μ; at cloaca, 20 μ; length of filiform portion of the tail, about 80 μ. The spicules are two in number, 38 μ long, similar in structure and form, with decided dorsal convexity and ventral concavity; the base is rather prominent, and measures about 10 μ dorsoventrally. An accessory chitinous piece is present, somewhat caudad of the spicules. Three distinct caudal papillæ are clearly visible. One of these is postanal and two are preanal. No copulatory bursa is present. A single testicle is present, extending anteriorly beyond the middle of the body.

Some slight variation was noticed in different specimens. Thus, in a specimen 1.36 mm. long, the esophagus measured 192 μ; the spicules were 36 μ long, with a base of 8 μ; the anus was 160 μ from the tip of the tail. In another specimen, 1.44 mm. long, the esophagus measured 196 μ long; spicules, 36 μ long, with a base of 8 μ; anus, 164 μ from tip of tail. Some variation was also noticed in the position and number of the caudal papillæ; while most specimens exhibited only three as described above, several males were found with four, and in one or two instances with five. It does not seem impossible to us that the normal number is greater than three, but that one or more are overlooked even upon a very careful examination.

Females.—Females were found measuring from 1 to 2.4 mm. in length. In a female measuring 1.74 mm. in length, the diameter of the body was 40 μ, the buccal cavity 8 μ long, the esophagus 200 μ long, the anus 244 μ from the tip of the tail. In a specimen 1.6 mm. long the esophagus was 200 μ long, vulva 712 μ from the mouth, anus 240 μ from tip of tail. In a specimen 1 mm. long, in which no embryos were developed, the esophagus measured 180 μ long, the anterior portion measuring 112 μ, the middle portion 48 μ, the esophageal bulb 20 μ in length. The dorsoventral diameter of the body in the middle was 20 μ, at the anus 18 μ. The rectum was very distinct, 32 μ long; the anus 160 μ from the tip of the tail. The largest specimen found was 2.4 mm. long by 72 μ in diameter. It contained embryos measuring 222 μ long by 12 μ in diameter. The vagina was a narrow tube 21 μ long, running at right angles to the exterior, and about 1.5 μ broad.

Fig. 10 shows a gravid female. It will be noticed that the vulva is slightly caudad of the equator of the body, and that the vagina branches into a bicorned uterus. The anterior horn of the uterus extends forward nearly to the esophagus, then curves and runs caudad a short distance. The posterior horn of the uterus extends caudad nearly to the anus, then curves and runs cephalad toward the vulva. As a rule, comparatively few eggs are found at any one

time in a given specimen. They may be in different stages of development, the embryo forming in the uterus. In some cases embryos are found in both uteri; in other cases they are confined to one horn of the uterus.

Biology of the parasites.—In five samples of urine taken the parasites were found in great numbers. The urine was always very acid, and in some samples which slowly became alkaline the worms died about the same time with the change in reaction of the urine. One of the samples of urine had a decided odor like that of vinegar, and in this specimen the parasites lived for two months, at the end of which time signs of life were very feeble, though the urine was still acid. Six of the worms were then removed from the urine and placed in two test tubes containing vinegar free from parasites. Their movements quickened in a few hours, and, from seeming almost dead, they became in a day or two as vigorous as ever. In one month they increased greatly by breeding, and within two months after their transfer from urine to vinegar there were enough of them in one of the tubes to make the fluid appear turbid.

Parasites in three diluted specimens of urine, one of which was allowed to remain acid, and two rendered neutral and slightly alkaline, respectively, with caustic soda, lived but a short time; those in the fluid of acid reaction living 10 days and in the others only half so long.

Apparently there was some substance in the urine and the vinegar which sustained life in these creatures. It is stated by several authors that certain albuminous matter in poorly prepared vinegar constitutes their food; and this would lead to the supposition that albumen was present in the urine.

Medical aspects of the infection.—The patient had chronic parenchymatous nephritis of a degenerative type, and the urine had frequently contained albumen. The parasites were present in the bladder for a period of thirty-three days after they were first observed, and during this time tests with heat and nitric acid failed to indicate the presence of any albumen. No symptoms traceable to the infection by the parasites occurred. There were severe headache and marked constipation during the time of their presence, but these conditions were of quite usual occurrence, and were not supposed to be caused by the worms, which disappeared from the urine without any specific treatment.

Source of infection.—Efforts to explain the occurrence of the vinegar worm in the bladder were not altogether successful. It seems scarcely reasonable, and entirely without analogy, to assume that vinegar eels upon being swallowed by a person would bore through the intestinal wall and finally reach the bladder. It seems much more reasonable to assume that they entered through the urethra. Our first thought was that the patient had used vaginal douches acidulated with vinegar, but

this she denied. While she was not entirely free from hysterical tendencies, no grounds are present for assuming that she introduced the parasites for the purpose of mystifying her physician.

That vaginal douches, acidulated with vinegar, are occasionally used to prevent conception is well known. A moment's consideration will show that such douches might lead a physician into error in diagnosis, since young vinegar eels, if present, might easily be mistaken for other parasites. On this account a condensed key to the worms reported for the urine and the vagina may be of interest:

KEY TO CLINICAL DIAGNOSIS OF WORMS IN THE URINE AND IN THE VAGINA.

1. Eggs present 2
   Embryos present 3
   Adults present 6

Eggs.

2. Eggshell thick, ellipsoid, 64 to 68 μ by 40 to 49 μ, with mosaic structure; embryo not developed; indicates infection of kidney ..... *Dioctophyme renale.*
   Eggshell ovoid, 135 to 160 μ by 55 to 66 μ, without mosaic structure, usually with sharp spine; contains ciliated embryo; indicates infection of blood vessels with trematodes (Egyptian hematuria, bilharziosis) ..... *Schistosoma hæmatobium.*
   Eggshell thin, oblong, 50 to 54 μ by 20 to 27 μ, contains elongate worm; indicates infection of rectum with pinworms; not found in urine of male patients ..... *Oxyuris vermicularis.*

Embryos.

3. Embryo ciliated (bilharziosis) ..... *Schistosoma hæmatobium.*
   Embryo not ciliated, elongate 4
4. Esophagus distinct, with posterior bulb armed with chitinous teeth (rhabditiform embryos) 5
   Esophagus not very distinct, no posterior bulb; same embryos also found in the blood, 270 to 300 μ long ..... "*Filaria sanguinis hominis.*"
5. Embryo 140 μ long; adults 3 to 12 mm. long in rectum ..... *Oxyuris vermicularis.*
   Adults in urine, but not in rectum 9

Larvæ and adults.

6. Elongate and flat; tapeworm larva ..... *Spargamum Mansoni.*
   Body round 7
7. Body large, may attain 40 to 100 cm. in length; usually red in color ..... *Dioctophyme renale.*
   Body less than 12 mm. long, whitish 8
8. Body 3 to 12 mm. long; male with single spicule; same parasite found in rectum. *Oxyuris vermicularis.*
   Body less than 3 mm. long; male with two spicules and accessory piece 9
9. Male without caudal bursa ..... *Anguillula aceti.*
   Male with caudal bursa ..... *Rhabditis pellio.*

Explanation of Plate V.

Fig. 14.[a] Full-grown male of *Strongylus subtilis*: *b.*, bursa with asymmetrically arranged rays; *c. g.*, cervical glands; *c.*, cloacal opening; *e. p.*, excretory pore; *i.*, intestine; *n. s.*, nervous system; *œ.*, esophagus; *œ. gl.*, esophageal gland; *r. m.*, retractor muscle of the spicules; *sp.*, spicules; *v. s.*, vesicula seminalis. (After Looss, 1895, fig. 1.)

Fig. 15. Full-grown female of *Strongylus subtilis:* *a.*, anus; *c. g.*, cervical glands; *e. p.*, excretory pore; *i.*, intestine; *n. s.*, nervous system; *œ.*, esophagus; *œ. gl.*, esophageal gland; *ov. a.*, anterior ovary; *ov. p.*, posterior ovary; *r. s.*, receptaculum seminis; *u. a.*, anterior uterus; *u. p.*, posterior uterus; *va.*, vagina; *vu.*, vulva. (After Looss, 1895, fig. 2.)

Fig. 16. Anterior end of female, showing the papillæ-like structure on the anterior extremity: *œ.*, esophagus; *œ. gl.*, the esophageal gland, with its opening (*o. œ. gl.*) into the funnel-shaped buccal cavity. (After Looss, 1895, fig. 3.)

Fig. 17. Spicules of the male with trowel-shaped accessory piece. (After Looss, 1895, fig. 4.)

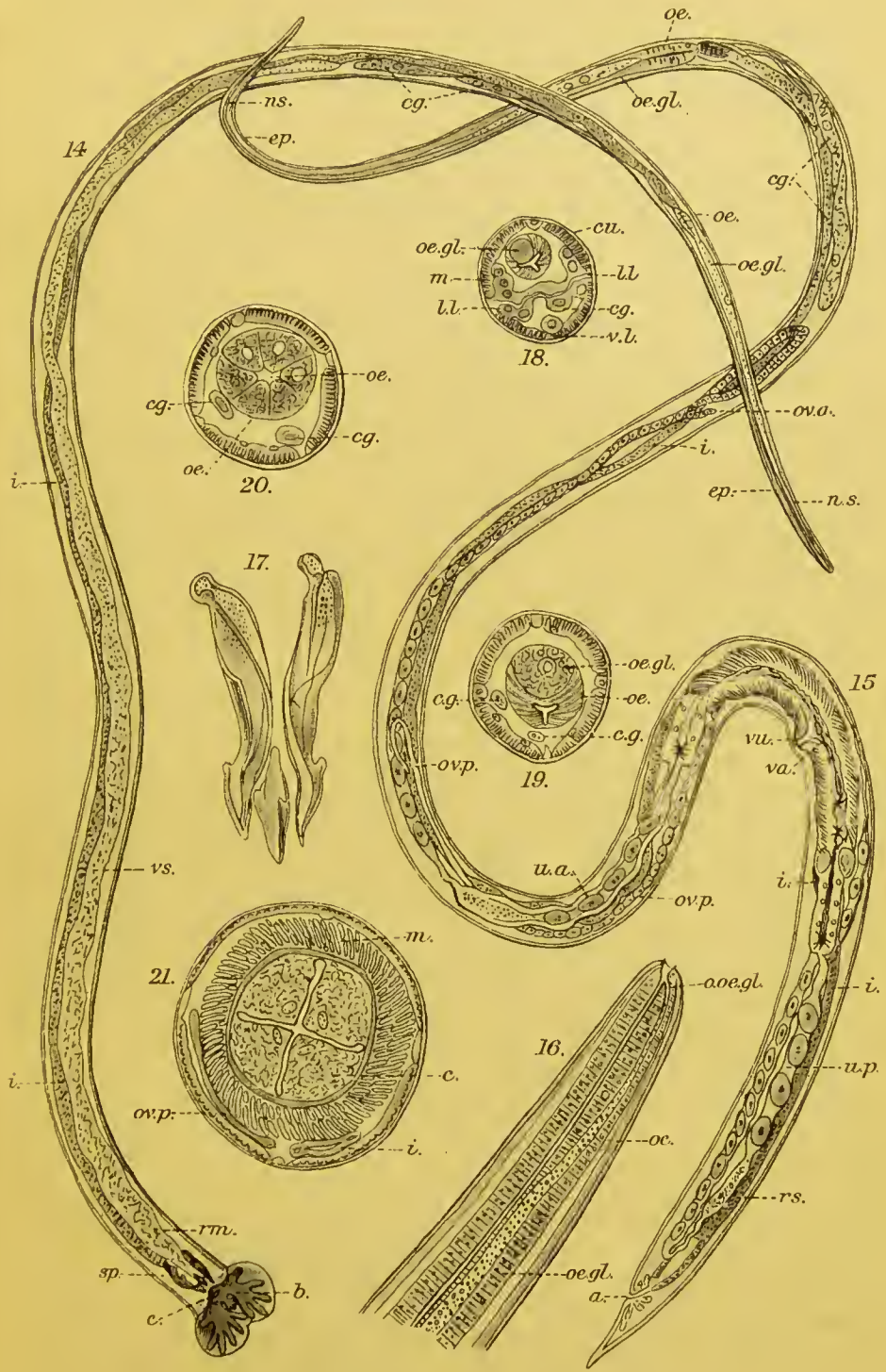
Fig. 18. Transverse portion of a male slightly posterior of excretory pore: *c.*, common excretory canal; *c. g.*, cervical glands; *cu.*, cuticle; *d. l.*, dorsal line; *œ.*, esophagus, with its three-starred lumen; *œ. gl.*, esophageal gland, in the wall of the esophagus; *l. l.*, lateral lines; *m.*, muscular layer; *v. l.*, ventral line. (After Looss, 1895, fig. 5.)

Fig. 19. Transverse section through the middle portion of the esophagus. Lettering the same as in fig. 18. Note that the radiate structure of the esophageal wall agrees with fig. 18. (After Looss, 1895, fig. 6.)

Fig. 20. Transverse section through the posterior portion of the esophagus. Lettering the same as in fig. 18. Note that the radiate structure of the esophageal wall is replaced by six large cells. (After Looss, 1895, fig. 7.)

Fig. 21. Transverse section through proximal portion of distal part of vagina, showing the peculiar muscular layer, cell layer with peculiar lumen, compressed intestine, and oviduct. (After Looss, 1895, fig. 8.)

[a] In figures 14 and 15 the diameter is purposely drawn out of proportion to the length, so as to bring out the organs clearly. All the figures are greatly enlarged.



Haines, del.

A. Hoen & Co., Lithocaustic

FULL-GROWN MALE AND FEMALE STRONGYLUS SUBTILIS

AN EGYPTIAN AND JAPANESE STRONGYLE (STRONGYLUS SUBTILIS) WHICH MAY POSSIBLY OCCUR IN RETURNING AMERICAN TROOPS.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry

[Plate V, figures 14-21.]

Among the parasites not known at present for North America, which must be considered in connection with the return of American troops from the East, should be mentioned a very small strongyle found in the stomach and upper portion of the small intestine. This nematode was first discovered in Japan by Ogata, then in Egypt, by Looss, and was referred to later by Ijima from Japan. The presence of the worm in those two countries, so widely separated geographically, would seem to indicate an extensive geographical distribution for the species.

The parasite in question is a roundworm belonging to the family Strongylidæ, and is usually placed in the genus *Strongylus*. This genus contains rather a heterogeneous assemblage of worms which will later undoubtedly be divided into several genera, and a general systematic revision of the family Strongylidæ will eventually result in certain important changes in the technical names. For the purpose of this article the generally adopted nomenclature will be followed.

Genus Strongylus.

Generic diagnosis.—Strongylidæ: Body slender; anterior extremity occasionally with alæ. Mouth small, without teeth, lips soft, often indistinct, papillæ very small. Bursa (male) entire, or excised ventrally, in some cases bi-, tri-, or multi-lobed; spicules 2, often with accessory piece. Vulva usually in caudal half of body; uterus with two horns.

Strongylus subtilis[a] Looss, 1895.

Specific diagnosis.—*Strongylus:* Very small, 4 to 7 mm. long; cuticle with exceedingly fine transverse striation; oral papillæ exceedingly small and inconspicuous; longitudinal lines well developed; lateral lines more prominent than the median. Buccal cavity short, funnel-shaped; œsophagus (0.75 mm. by 7 to 30 μ) nearly one-sixth as long as body, differentiated histologically into anterior and posterior portions, and containing well-developed dorsal esophageal gland which discharges at its anterior extremity; intestine short, 13 μ in diameter. Nervous system about 0.16 mm. from anterior extremity. Excretory pore about 0.19 mm. from anterior extremity; cervical glands well developed, one extending posterior of the other and for nearly the length of the œsophagus posterior of this organ.

Male.—Four to 5 mm. long, increasing in diameter from 9 μ at anterior end to 70 μ near the bursa. Testicle single, beginning near the posterior end of cervical gland;

[a] Synonymy and Bibliography.

(1889): *Strongylus* [sp.] Ogata, 1889, No. 578. [After Ijima.]

1895: *Strongylus subtilis* Looss, 1895, pp. 161–169, pl. 1, figs. 1–8.—Idem, 1896, pp. 864–865.—Ijima, 1896, pp. 155–159.—R. Blanchard, 1895, p. 810.—Delafield & Prudden, 1897, p. 137.—Stossich, 1899, p. 79.—Stiles, 1902, pp. 41–42, figs. 14–21.

vesicula seminalis present; spicules 0.15 mm. long; accessory piece trowel-shaped, single, about one-third as long as spicule; bursa bilobed, about as long as spicules, somewhat broader than long, with narrow ventral connection; rays asymmetrical, dorsomedian stem with short bilobed posterior rays; then 1 dorsolateral ray on right, 2 on left; 3 lateral rays each side; finally, 1 (ventral) right and 2 left short ventral rays.

Female.—5.6 to 7 mm. long, increasing in diameter from 10 μ at head to 90 μ in posterior third of body. Anus 97 μ from tip of sharply pointed tail. Vulva about at beginning of posterior fifth of body, a 40 μ longitudinal opening bounded by two chitinous labia; unpaired vagina short, dividing into two proximal horns, each 0.3 mm. long; next follows on each horn a complicated valvular apparatus divided into a proximal 0.2 mm. long muscular portion and a 0.1 mm. long distal portion with thinner muscular layer; uteri 0.33 to 0.4 mm. long, each containing 3 to 6 unsegmented (in camels 7 to 8 unsegmented or partially segmented) eggs; the distal portion serving as a receptaculum seminis; anterior genital canal extends to near posterior end of cervical glands, then turns and runs a short distance caudad; posterior genital canal runs to near anus, turns and extends to near the equator of the body.

Eggs.—Oval, 63 by 41 μ (in camels 70 by 36 μ), shell thin, contents very granular, unsegmented in uterus (in camel they may be partially segmented).

Development.—Not demonstrated; probably direct, without intermediate host; source of infection, probably drinking water or contaminated food.

Habitat.—Stomach and upper portion of small intestine of man (*Homo sapiens*) in Egypt and Japan; intestine of camels (*Camelus dromedarius*).

Clinical diagnosis.—Microscopic examination of feces to find eggs will be uncertain, unless the infection is very heavy. The medical importance of this species is not yet determined; the parasite is perhaps comparatively harmless. All cases thus far reported were diagnosed post-mortem.

Treatment.—Probably thymol.

Looss found this worm several times in both Alexandria and Cairo, Egypt, while making microscopic examinations of the intestinal content of human cadavers. All of the infected bodies were of inhabitants of the flat lands. The infections were all light, and it was noticed that the male parasites were less frequent than the females. Looss concluded that owing to the small size of the worm, its unarmed mouth, and the fewness of the individuals, a pathologic rôle could hardly be attributed to it. Later (1896) Looss reported the same parasite for the camel.

An article by Ijima would seem to leave the question open as to whether the worm is of any medical importance. Ogata had found about two hundred small nematodes in the stomach of a woman who died during the "Miura plague" of 1889. These he described briefly in the Tokoyo-medicinische Wochenschrift; they were identical with Looss's *Strongylus subtilis*. There is no attempt to consider the worms as the cause of the Miura epidemic, but Ijima rightly remarks that the presence of a large number of such parasites can not be lightly dismissed as harmless.

AN ADULT CESTODE (DIPLOGONOPORUS GRANDIS) OF MAN WHICH MAY POSSIBLY OCCUR IN RETURNING AMERICAN TROOPS.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry,

and

Louise Tayler, M. S.,
Assistant, Bureau of Animal Industry.

[Figures 22–28.]

Upon several occasions one of us has called attention to the fact that our troops, upon returning to this country from their Asiatic service, may bring back with them certain animal parasites which are not familiar to American practitioners. The object of the present paper is to call attention to an adult Asiatic tapeworm, which is very different from the American forms. Described in a few words, it belongs to the family Bothriocephalidæ, subfamily Dibothriocephalinæ, and is similar to *Dibothriocephalus latus*, the broad Russian tapeworm (usually known as *Bothriocephalus latus*), differing, however, from that form in that every segment has a double instead of a single set of genital organs.

The generic and specific diagnoses and synonymy of this parasite are as follows:

Genus Diplogonoporus[a] (Lönnberg, 1892).

Generic diagnosis.—Dibothriocephalinæ: Scolex short, with two strong, grooved suckers. Neck absent. Proglottids short and broad. In each segment two sets of genital organs, otherwise like *Dibothriocephalus*. In each segment may be recognized the following: Median field, two uterine fields, and two lateral fields. Genital pores (cirrus, vaginal, uterine) ventral in longitudinal row in uterine field; vitellogene glands and testicles in lateral and median fields. Vitellogene follicles between inner and outer longitudinal muscles. Uterus forms rosette. Parasites in man and whales.

Type species.—*Diplogonoporus balænopteræ* Lönnberg, 1892.

---

[a] Synonymy and Bibliography.

1892: *Bothriocephalus* (*Diplogonoporus*) Lönnberg, 1892,[b] pp. 3, 4 [type, *Diplogonoporus balænopteræ* Lönnberg, 1892, pp. 4–16, pl. 1, figs. 1–6, 8–9].

1894: *Krabbea* Blanchard, 1894, pp. 699–702 [type, *Krabbea grandis* Blanchard, 1894, pp. 699–702].—Idem, 1895, p. 708.—Idem, 1898, pp. 350, 351.—Stiles, 1895, p. 53.—Idem, 1896a, p. 24.—Idem, 1896b, p. 205.—Jacobi, 1897, p. 288.—Kholodkovski, 1898, pp. 19, 22. [See also Ariola, 1900, pp. 377, 378, 383.—Lühe, 1899, pp. 49, 50.—Braun, 1900, pp. 1669, 1690.—Ward, 1901, p. 793.]

1897: *Diplogonoporus* (Lönnberg) Jacobi, 1897, p. 288.—Lühe, 1899, pp. 49, 50, 54.—Idem, 1900, pp. 210, 212.—Braun, 1900, pp. 1683, 1690.—Ariola, 1900, pp. 377, 378, 380, 381, 383.—Kurimoto, 1900, p. 14.—Ward, 1901, pp. 783, 793.

[b] These short bibliographic references are to articles, the full bibliographic titles of which may be found by consulting the Index-Catalogue of the Surgeon-General's Library or the card catalogue of the Zoological Laboratory of the Bureau of Animal Industry, now being prepared for press.

The Double-pored Asiatic Tapeworm Diplogonoporus grandis[a] (Blanchard, 1894) Lühe, 1899.

Specific diagnosis.—*Diplogonoporus:* Strobila attains 10 meters in length, 10 to 25 mm. in breadth; number of segments (?). Head undescribed. Neck undescribed. Genital pores open in two longitudinal genital grooves. Gravid segments contracted in alcohol to 0.45 mm. long, 14 to 16 mm. broad. Uterus with but few (about two) loops each side. Eggs brownish, rather opaque, 63 μ long, 48 to 50 μ broad.

Host.—In the intestine of man, Japan; larva unknown, in all probability in fish.

This parasite was originally described by Ijima and Kurimoto (1894) as an undetermined species of *Bothriocephalus;* Blanchard (1894) created the genus *Krabbea* for it, proposing the specific name *grandis;* Lühe (1899) showed it to be congeneric with *Diplogonoporus balaenopterae*, a form reported for seals.

Fig. 22.—Dorsal view of a portion of the strobila of the double-pored large tapeworm (*Diplogonoporus grandis*) of man. Natural size. After Ijima & Kurimoto, 1894, fig. 1.

Fig. 23.—Ventral view of same. After Ijima & Kurimoto, 1894, fig. 2.

Our entire medical knowledge of the worm we owe to Ijima and Kurimoto. Together they described, in 1894, the first-known case of infection with this parasite. A second case was described by Kurimoto in 1900. The statements made by other authors are all based upon these two papers. The essential zoological facts presented in these articles, so far as they are necessary to the physician, are summarized in the diagnoses given above. As the publications in question are accessible to only a few of the physicians in this country, it may be well to quote the more important original data bearing upon the medical side of the subject.

Fig. 24.—Transverse section of same. After Ijima & Kurimoto, 1894, fig. 3.

The clinical histories reported for the two known cases are as follows:

Case 1.—*History:* "Tamaji Murazato, male, born 1865, at Taira-mura (a village on the Ariake Sea, near the town of Shimabara), in the province Hizen. In boyhood healthy, but never muscular. Remained in his native village until 1879, when he went to Nagasaki. Here attacked by cholera, but recovered. Up to 1892 resided in several places in the neighborhood of Nagasaki and other seaside localities within

---

[a] Synonymy and Bibliography.

1894: *Bothriocephalus* sp. Ijima & Kurimoto, 1894, pp. 371–385, pl. 18, figs. 1–12.

1894: *Krabbea grandis* Blanchard, 1894, pp. 699–702.—Idem, 1895, p. 728.—Idem, 1898, p. 350.—Stiles, 1896a, p. 25.—Idem, 1896b, p. 221.—Stiles & Hassall, 1898, pp. 85, 137.—Huber, 1896, pp. 561–562.—Moniez, 1896, pp. 255, 274–276.—Simon, 1897, pp. 209, 222.—Idem, 1900, pp. 217, 229.—Kholodkovski, 1898, p. 22, pl. 10, figs. 1–4.—Kurimoto, 1899, p. 406. [See also Kurimoto, 1900, p. 14.—Lühe, 1899, p. 50.]

1899: *Diplogonoporus grandis* (Blanchard, 1894) Lühe, 1899, p. 50.—Idem, 1900, p. 211.—Ariola, 1900, pp. 385–386.—Kurimoto, 1900, pp. 1–16, pls. 1–2.—Ward, 1901, pp. 783, 793, figs. 1244–1245.

the Province Hizen, outside of which he seems to have never traveled. Calling: Amanuensis, post-office clerk, school-teacher, etc.; 1891 settled at Takashima coal mines, where he had been engaged in bookkeeping business until his death by accident in November of the following year. Some five years previous to this period he began to suffer occasional dizziness and colic. Medical help had not much effect beyond palliating the latter. Gradual anemia supervened. During October, 1892, a piece of tapeworm about 1 foot long was discharged. About this time violent colic is said to have returned. He was then taken into the hospital before mentioned and submitted to medical treatment by Mr. Nakamura." * * *

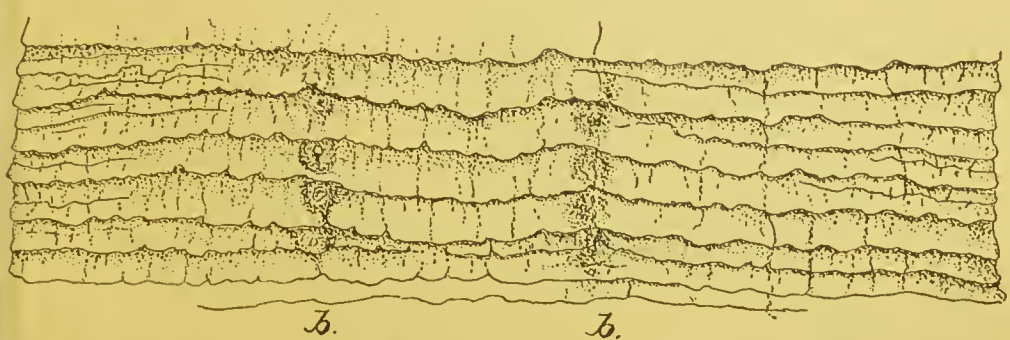


FIG. 25.—Ventral view of a portion of the strobila, showing two rows of genital pores, with partially extruded cirri. X 10. After Ijima & Kurimoto, 1894, fig. 6.

Symptoms: "Medium bodily constitution. Badly nourished; weary. Symptoms of cyanosis on face. Liable to fall into insensibility while sitting or otherwise occupied. Pulse weak and frequent, numbering 120. Palpitation somewhat accelerated. Temperature, 36.8° C. Tongue with yellowish covering. Appetite ordinary; sometimes vigorous. Gastric region swollen out and frequently giving spasmodic pain, radiating towards the back and ceasing gradually or suddenly, followed by a feeling of pressure on intestines. This feeling either remains at one place or shifts its position. The attack occurs after taking food, but also at other times. Pressing

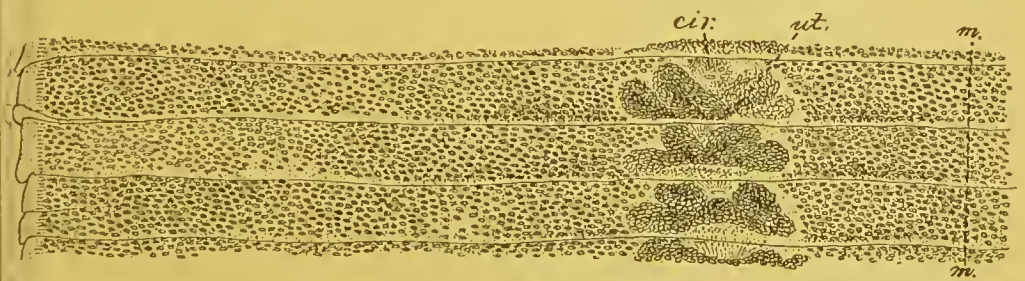


FIG. 26.—Ventral view of lateral half of a few segments of same; *m, m,* median line; *cir,* cirrus; *ut,* uterus; the numerous dot-like bodies on either side of the uteri represent the yolk glands. X 20. After Ijima & Kurimoto, 1894, fig. 7.

the gastric region from outside has soothing effect on the pain. Sometimes pain also in the pelvic region. Diarrhea or costiveness for many days."

Treatment: "From above symptoms the presence of *Ancylostomum duodenale* [=*Uncinaria duodenalis*] was suspected. Microscopical examination of the feces, however, unexpectedly revealed a number of eggs, resembling very much those of *Distomum Ringeri* [=*Paragonimus Westermanii*] both in size and appearance. Irrespective of what parasite these eggs might belong to, a dose of *extr. filic. mas.* was tried, and the result was the discharge of a tapeworm measuring *10 meters* in length and at the broadest portion 25 millimeters in breadth. The broad hind end had its extreme tip shrunk, much macerated, and easily detachable. Of the other end, a

portion as thin as 1.5 millimeters was found, but no head could be discovered. From the following day all the complaints the man had suffered from for so many years entirely disappeared."—*Ijima & Kurimoto, 1894, pp. 372–373.*

Case II.—*History:* C. A.; 24 years; resident of Nagasaki. He went frequently to the vicinity of Minamitakaki, where the first case had lived, in order to buy eggs. In 1890 changed his occupation to hauler and day laborer until 1896. He had never been anywhere outside of his native district except in Minamitakaki; naturally healthy, with no history of previous illness; since July, 1895, occasional pain in abdo-

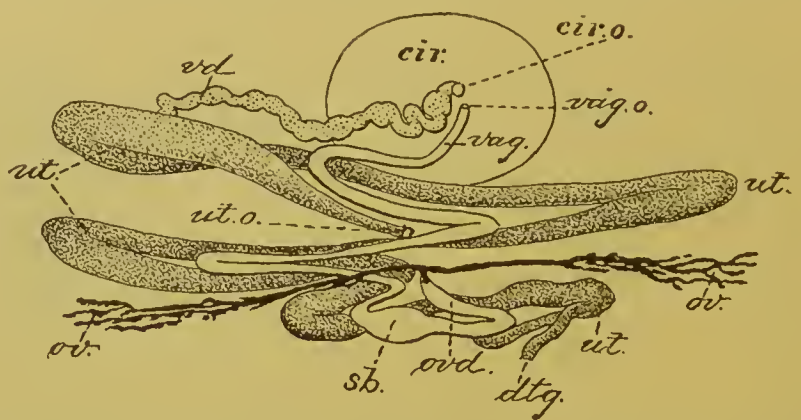


Fig. 27.—Partially diagrammatic representation of a left set of main genital ducts, as seen from the ventral side; *cir*, cirrus; *cir. o*, cirrus opening; *dtg*, yolk duct; *ov*, ovary; *ovd*, oviduct; *sb*, receptaculum seminis; *ut*, uterus; *ut. o.*, uterine pore; *vag*, vagina; *vag. o*, vaginal opening; *vd*, vas deferens. × 150. After Ijima & Kurimoto, 1894, fig. 10.

men, transitory diarrhea followed by constipation; morning of January 26, 1896, taken with intense cramps and diarrhea; found something suspicious in his stool, which he took to his physician for examination.

Symptoms: Body medium, nourishment medium. Body showed no changes, only a gurgling sound from time to time in abdomen. Pieces of tapeworm were found in the stool, whereupon *extr. filic. mas.* was given. Two tapeworms without heads were discharged. One of them measured 145 cm. in length and from 3.5 to 7 mm. in width (the narrow end caudad). The second measured 140 cm. in length, 0.5 mm. in width at anterior end, 8 mm. in width at broadest posterior part.—*Abstracted from Kurimoto, 1900, p. 5.*

Clinically, it may be noticed that while the symptoms are varied and not especially characteristic, they correspond in a general way to those noted in infections with *Dibothriocephalus latus*, namely, irregular appetite, with occasional pains extending from region of stomach to the back; intestinal disturbance indicated by diarrhea, colic, and constipation; anemia, as is more or less common in infection with worms of this family (absent from second case probably because of the small size of the parasite); poorly nourished condition, weakness, inclination to faint.

Fig. 28.—An egg taken from the uterus. × 440. After Ijima & Kurimoto, 1894, fig. 9.

Diagnosis should be very easy. If segments are found in the stools, they can be easily determined by pressing them gently between two pieces of glass, holding them up to the light, and looking for the characters mentioned in the

diagnoses given above. If no segments are found, a microscopic examination of the feces will reveal numerous eggs, since this parasite belongs to a group of worms provided with a special uterine pore, through which the ova are constantly discharged. These eggs are entirely different from those of the genus *Taenia*, being provided with an operculum at one end. They may, however, be mistaken for eggs of certain other parasites. The forms which come into special consideration are *Dibothriocephalus latus* (the broad Russian tapeworm), *Fasciola hepatica* (the common liver fluke), and *Paragonimus Westermanii* (the lung fluke). It will be somewhat difficult to distinguish the eggs (63μ by 48 to 50μ) of the Asiatic tapeworm (*Diplogonoporus grandis*) from those of the broad Russian tapeworm, which measure 68 to 70μ by 44 to 45μ; the eggs of *Fasciola hepatica* are much larger, namely, 105 to 145μ by 63 to 90μ; those of *Paragonimus Westermanii* are also larger, 68 to 118μ by 48 to 60μ, and are found both in the sputum and feces.

In connection with the source of infection, suspicion points strongly to fish as the intermediate host, though the life history of the parasite has not yet been established.

In treatment, male fern alone has thus far been used, but in neither case was the head found. At present nothing indicates that the treatment for this tapeworm should neeessarily differ from treatment for *Taenia*.

A LARVAL CESTODE (SPARGANUM MANSONI) OF MAN WHICH MAY POSSIBLY OCCUR IN RETURNING AMERICAN TROOPS.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry,

AND

Louise Tayler, M. S.,
Assistant, Bureau of Animal Industry.

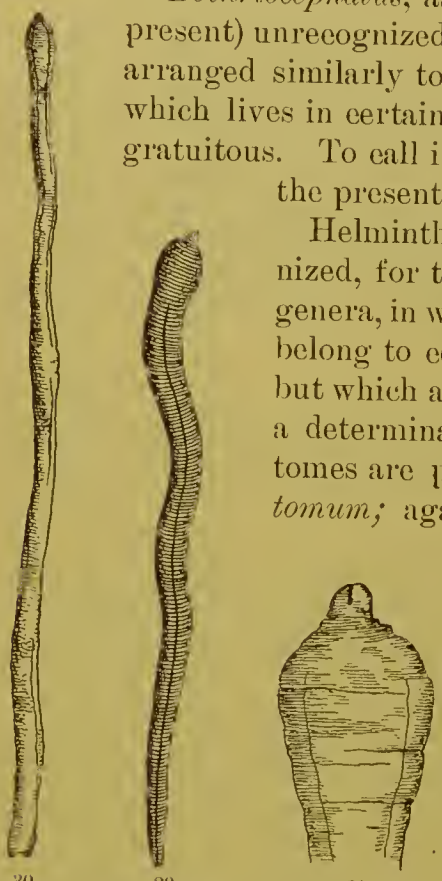
[Figures 29-36.]

In a former paper[a] we have called attention to an adult Asiatic cestode (tapeworm) which might, perhaps, be introdueed into this country by the returning troops. In the present article attention is directed to a larval cestode which is reported for man in Asia, but whieh is as yet unknown for America. This, also, is one of the parasites whieh may be found in American troops who have served in the East.

The exact systematic position of the worm in question is at present somewhat uncertain. Cobbold originally placed it in the genus *Ligula;* Leuckart transferred it to *Bothriocephalus;* Ariola has recently called it *Dibothrium*, which is a synonym of *Bothriocephalus.*

[a] An adult cestode (*Diplogonoporus grandis*) of man in Asia, which may possibly occur in returning American troops. (See above, pp. 43–47.)

From our present knowledge of systematic helminthology there appears to be no doubt that the parasite belongs in the family Bothriocephalidæ. Of what particular natural genus it is a member is purely a matter of speculation, since the genera of this family are based largely upon the arrangement of the genitalia, and in the larval specimens under consideration no genital organs are as yet developed. The absence of any indication of such structures in the larval stage excludes it from the genus *Ligula* as at present defined; and to place it in *Bothriocephalus*, as now defined, is to assume that the (at present) unrecognized adult stage will have its genital organs arranged similarly to those of *Bothriocephalus bipunctatus*, which lives in certain fishes. Such an assumption is purely gratuitous. To call it a *Dibothrium* is not permissible under the present rules of nomenclature.



30 29 31

FIG. 29.—*Sparganum Mansoni*. Natural size. After Cobbold, 1883, fig. a. FIG. 30.—Another specimen of same. Natural size. After Leuckart, 1886, p. 942, fig. 402 A. FIG. 31.—Head end of same. × 5. After Leuckart, 1886, p. 950, fig. 405.

Helminthologists have from time to time recognized, for the sake of convenience, certain agamic genera, in which are collected all those forms which belong to certain larger groups, such as families, but which are not developed to a degree permitting a determination of the genus. Thus, agamic distomes are placed in the artificial genus *Agamodistomum;* agamic amphistomes in *Amphistomulum*, etc. By such an arrangement accepted genera are relieved of the artificial and often conglomerate status which would be given to them by using them as collective groups in which to place undeterminable forms.

Diesing (1854) proposed the generic name *Sparganum* for a collective group, of biologic rather than systematic value, to contain certain larval tapeworms which could not be definitely determined, thus corresponding to *Agamodistomum* and *Amphistomulum*. *Sparganum* has not been generally accepted by recent authors, but we believe its adoption advisable. The parasite now under discussion should be placed in this group.

COLLECTIVE GROUP SPARGANUM[a] DIESING, 1854.

GENERIC DIAGNOSIS.—Bothriocephalidæ: Larval forms; sexual organs absent, so that generic determination is impossible. An artificial collective group, without type species.

---

[a] BIBLIOGRAPHY.

1854: *Sparganum* DIESING, 1854, pp. 573–574.—BRAUN, 1900, p. 1676.

SPECIES SPARGANUM MANSONI[a] (COBBOLD, 1882).[b]

SPECIFIC DIAGNOSIS.—*Sparganum:* Length, 8 to 36 cm.; breadth, 0.1 to 12 mm.; thickness, 0.5 to 1.75 mm. Anterior end may be broader than posterior. Flat, not segmented, but with irregular transverse folds; ventral surface usually with distinct longitudinal median groove; dorsal surface may show two longitudinal grooves. Anterior margin rounded, with papilliform elevation on which is found the head. The latter somewhat compressed and more or less invaginated.

HABITAT.—Subperitoneal connective tissue and body cavity of man (*Homo sapiens*) in Amoy and Japan; Sonsino reports it for the jackals (*Canis aureus*), in Egypt.

The presence of a larval cestode in man must, from a biological standpoint, be looked upon either as abnormal and more or less accidental or as a survival from savage and prehistoric times, since the normal hosts for larvæ are animals which serve as food for the hosts of the adult stages. If any given larva were dependent upon man as intermediate host the parasitic species would soon become extinct, since man does not serve as food for any animal, though, of course, occasionally eaten by insects, crabs, carnivorous fish, reptiles, birds, and mammals.

The presence of *Sparganum Mansoni* in man appears, accordingly, to be biologically abnormal and accidental. The normal host for this larva and the normal host for the adult stage are still unknown, but it may be noted with interest that Ijima & Murata (1888, p. 160) report a larval cestode resembling *Sparganum Mansoni* from an ape

---

[a] SYNONYMY AND BIBLIOGRAPHY.

1882: *Ligula Mansoni* COBBOLD in Manson, 1882 (Oct. 4), p. 617.—COBBOLD, 1883, pp. 78–83, figs. a–d.—RAILLIET, 1886, p. 276.

1886: *Bothriocephalus liguloides* LEUCKART, 1886a, pp. 862, 941–951, figs. 402–403, 405.—IDEM (Hoyle, trans.), 1886b, pp. 682, 745–751, figs. 402–404.—IJIMA & MURATA, 1888, pp. 149–162, pl. 5 bis, figs. 1–8.—IJIMA, 1889, pp. 246–256, fig. 28.—DUNGLISON, 1893, p. 155.—IDEM, 1895, p. 155.—IDEM, 1900, p. 155.—MOSLER & PEIPER, 1894, p. 48.—SCHNEIDEMÜHL, 1896, p. 292.—STILES, 1896, p. 25.—WOOD & FITZ, 1897, p. 324.

1886: *Bothriocephalus Mansoni* (Cobbold) R. BLANCHARD, 1888, pp. 536–538, figs. 293 a–d.—IDEM, 1895, pp. 727–728.—IDEM, 1900, p. 486.—RAILLIET, 1893, pp. 327, 328.—BRAUN, 1895, pp. 202–203, fig. 103.—MONIEZ, 1896, pp. 272–274, figs. 59 a–d.—GAMBLE, 1896, pp. 81, 91.—STILES, 1896, p. 25.—IDEM, 1898, p. 85.—HASSALL, 1898, p. 137.—KHOLODKOVSKI, 1898, p. 22, pl. 9, figs. 20–21.

1896: "*Leguli Mansoni* Cobbold" of HUBER, 1896, pp. 560–561 (misprint for *Ligula Mansoni*).

1896: "*Bothriocephalus leguloides* Leuckart" of HUBER, 1896, pp. 560–561 (misprint for *B. liguloides*).

1897: "*Bothriocephalus linguloides* Leuckart" of SIMON, 1897, p. 510 (misprint for *B. liguloides*).

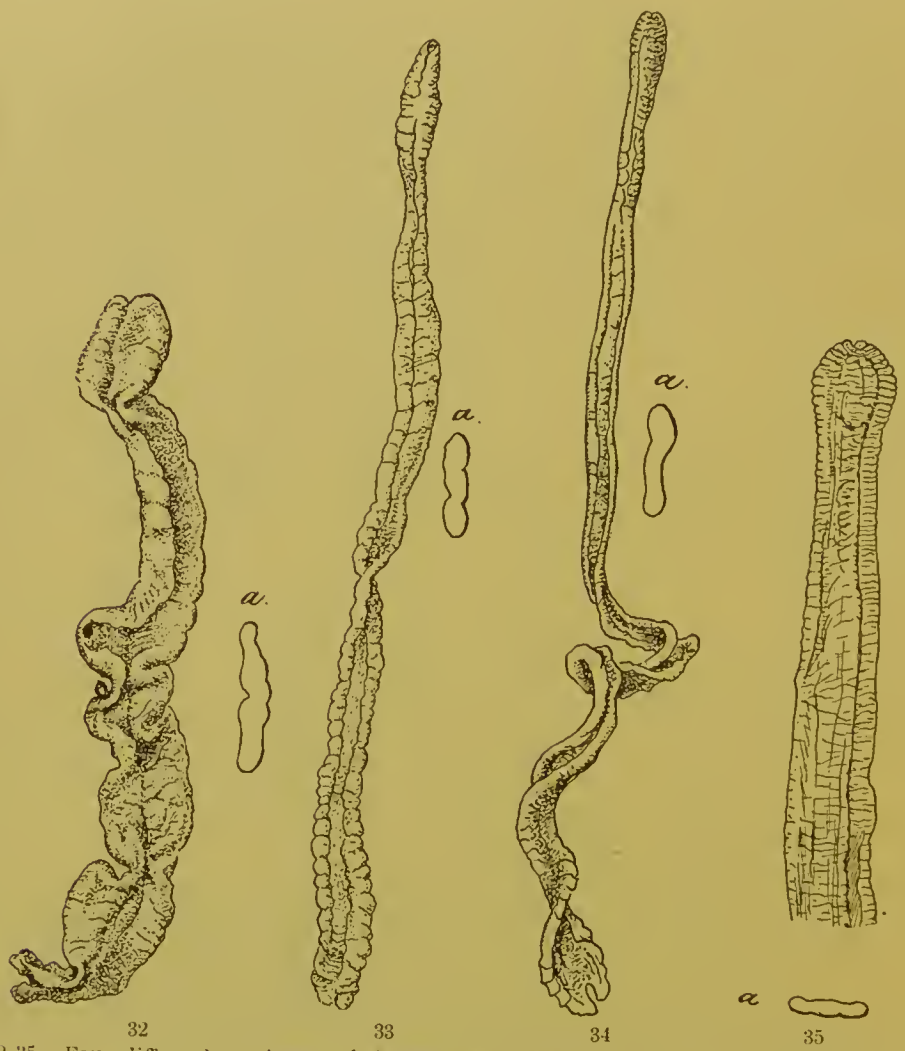
1900: *Dibothrium Mansoni* (Cobbold) ARIOLA, 1900, pp. 458–459, fig. 4.—WARD, 1901, pp. 783–793.

1902: *Sparganum Mansoni* (Cobbold) STILES & TAYLER, 1902, pp. 47–56, figs. 29–36.

[b] These short bibliographic references are to articles, the full bibliographic titles of which may be found by consulting the Index-Catalogue of the Surgeon-General's Library or the Index-Catalogue of Medical and Veterinary Zoology of the Zoological Laboratory of the Bureau of Animal Industry.

(*Innus speciosus*) and a martin (*Mustelus itatsi*). It is also striking that Sonsino (1889) reports from the jackal (*Canis aureus*) in Egypt, a specimen which he considers identical with *Sparganum Mansoni* in man.

Whether all of these forms can be recognized as specifically identical is, of course, a question, for since we are not able to determine even the genus of this larval parasite an absolute specific determination is naturally an impossibility. In fact, strictly speaking, we are not justified in claiming that it has been scientifically demonstrated that



FIGS. 32–35.—Four different specimens of *Sparganum Mansoni:* 32, 33, and 34, natural size; 35, 32, *a* represents outline of cross-section. After Ijima & Murata, 1888, pl. 5 bis, figs. 1, 3, 4, 5.

all of the worms from man, published as identical with *Sparganum Mansoni*, are in reality members of the same species. In the final analysis *Sparganum Mansoni* simply represents an indefinite collection of both riocephalid larvæ found in man, parasites which may belong to one or to several species.

A natural result of our incomplete zoological knowledge of the cestodes in question is that it is impossible to state with certainty how the patients became infected, hence it is impossible to suggest prophylactic measures.

Two possibilities in particular come into consideration: It is theoretically conceivable that the embryo of the parasite is swallowed with the drinking water, and that it then bores its way to various parts of the body. The possibility must also be admitted that the patients had eaten raw or rare fish, and that encysted larval parasites present therein had then wandered from the intestine to the connective tissue. Analogies of such wanderings of parasites are not entirely wanting, and it may further be noted that the cases of infection by this particular parasite thus far recorded have occurred in a part of the world where fish forms an unusually important article of diet. It would appear also, as has already been pointed out by other authors, that the parasites wander to some extent in the body of man. This is shown, for instance, by the cases where the worms escape from the urethra.

Thus far the 10 recorded cases of infection in man by *Sparganum Mansoni* may be divided as follows:

Geographically: Amoy, 1; Japan, 9.

By sex: Males, 7; females, 2; not stated, 1.

By age: 1 to 10 years, 1 case; 11 to 20 years, 3 cases; 21 to 30 years, 3 cases; 31 to 40 years, 1 case; 41 to 50 years, 1 case; not stated, 1 case. Thus, 6 out of 10 cases occurred between the ages of 11 and 30 years.

Seat of worm: Region of eye, 3 cases; escaped from urethra, 4 cases; connective tissue of abdominal region, 3 cases. [Pleural cavity, 1 case.]

Number of parasites present: Single parasite reported, 9 cases; 12 parasites reported, 1 case.

The cases in question may be tabulated as follows:

Case No.	Age and sex.	Country.	Seat of parasite.	Number of parasites.	Dimensions of parasite.	Authority.
I	34 years, male.	Amoy ..	Subp. conn. tiss., near iliac fossa and postrenal; 1 free in pleural cavity.	12	300 to 350 x 3 x 0.4 mm. 30 to 81 mm.	Manson, 1882, pp. 616–617; Cobbold, 1883, pp. 78–83.
II	28 years, male.	Japan ..	Wandered and discharged from urethra.	1	185 mm. long...	Leuckart, 1886a, pp. 941–951, figs. 402–403, 405; Leuckart, 1886b, pp. 745–751, figs. 402–404.
III	9 years, male.	....do ...	From urethra.....	1	300 x 10 x 1.75 mm.	Murata, 1887, No. 181, pp. 4–10; No. 182, pp. 6–10; Ijima & Murata, 1888, pp. 150–151, fig. 1.
IV	25 years, male.	....do ...	.....do	1	600 x 6 x 1.5 mm. 245 x 1 to 3 mm.	Murata, 1887, No. 185, pp. 4–7; Ijima & Murata, 1888, pp. 151–152, fig. 2.
V	42 years, male.	....do ...	.....do	1	364 x 12 mm. or 105 x 6.5 mm.	Toyoda, 1888, No. 2; Ijima & Murata, 1888, pp. 153–154, fig. 3.
VI	17 years, male.	....do ...	Region of eye	1	25 x 1.5 to 4 mm.	Murata, 1887, No. 181, pp. 4–10; No. 182, pp. 6–10; Ijima & Murata, 1888, p. 154.
VII	15 years, female.	....do ...	.....do	1	120 x 3 to 6 mm.	Murata, 1887, No. 185, pp. 4–7; Ijima & Murata, 1888, pp. 154–155, figs. 4, 6, 8.
VIII	24 years, male.	....do ...	Thigh	1	88 x 3.5 to 6.5 mm	Ijima & Murata, 1888, pp. 155–157, fig. 5.
IX	11 years, female.	....do ...	Region of eye	1	25 x 2 mm	Ijima & Murata, 1888, p. 161.
X	?	....do ...	Inguinal region	1	450 mm	Ijima & Murata, 1888, p. 157.

Clinical diagnosis.—Diagnosis will usually be made either upon opening a swelling and finding the worm, or upon postmortem, or upon seeing a portion of the worm at the opening of the urethra. Since we are dealing with an immature stage, ordinary methods of diagnosis by microscopic examination for ova will be useless.

Treatment.—From the position of the parasite it is clear that the administration of anthelmintics is not indicated. Surgical treatment is used in superficial swellings, while in urethral cases the worms should be extracted while the patient is in a warm bath, the parasite being slowly drawn out or wound out around a stick under water.

HISTORICAL REVIEW, WITH REPORT OF CASES.

The first record of this parasite was published by Manson (1882, pp. 616–617). It was a "Case of Lymph Scrotum, associated with Filariæ and other Parasites." Some of the "other parasites" were those sent to Cobbold, who identified them as a new species and called them *Ligula Mansoni*. Dr. Manson, who was in Amoy at the time, found these helminths in a Chinaman. The latter had died of dysentery and ulcerated stricture of the esophagus, after operation for lympho-elephantoid scrotum. Manson described the worms as follows:

CASE I. "A number of parasites, twelve in all, were found lying in the subperitoneal fascia, about the iliac fossæ, and behind the kidneys. A similar parasite was found lying free in the right pleural cavity. Some of these parasites were coiled up in loose knots, and others lay extended. On being drawn from under the peritoneum they exhibited languid movements like those of the tapeworm. * * * The parasites referred to as having been found in the subperitoneal areolar tissue were long, tape-like animals, 12 to 14 inches long, one-eighth of an inch broad, and about one sixty-fourth of an inch in thickness. They were dead white, and moved distinctly when taken out of the body. The extremities were rather thicker than the rest of the body and were rounded off. A hurried glance with the microscope showed one extremity to be lipped. I placed them in a mixture of serum and urine, intending to examine them more carefully in the evening of the post-mortem, but was disturbed. Next morning I poured spirits of wine over them. To-day I find them so friable that I can not make out the structures. There are no joints or articulations. The entire animal seems stuffed with clear, globular, egg-like bodies, in many of which double and treble outline, with appearance of nucleus, can be traced. These bodies are apparently held together by a loose fibrous matrix, which, on pressure, splits up longitudinally or ruptures transversely. The integument is very thin. One extremity appears to be provided with a narrow longitudinal slit, the other is distinctly lipped."—*Manson, 1882, pp. 616–617.*

An editorial footnote to this article states that Cobbold had proposed the name *Ligula Mansoni* for the parasites in question.

Cobbold (1883) gave a more detailed description of the worm the following year, publishing a specific diagnosis and discussing the possible modes of infection.

The next contribution to our knowledge of this parasite was by Leuckart (1884, 1886). The original paper of 1884 is not accessible to us, but in 1886 Leuckart gave an account of a case which was observed

by Dr. Scheube in Kyōto. Leuckart renamed the worm *Bothriocephalus liguloides* and gave an important zoological discussion of it. He disagrees with Cobbold in reference to its possible relation to *Ligula*. He is of the opinion that the entire body of the larval parasite will not change to an adult in a final host, but that the head and adjacent portion will give rise to the strobila, while the rest of the worm will be destroyed. The medical history of the case he cites is as follows:

Case II. "The patient was a Japanese, 28 years of age, who had been five years in prison, but was formerly for some years a groom in the island of Kiushiu, and had moved about in the west of the main island. During his residence in Kiushiu, he suffered, after a prolonged careless life, from hematuria. He became afterwards syphilitic and remained so till his imprisonment. After he had been four years in prison his left testis began to swell and became painful. At the same time a diffuse hardening of the skin set in on the upper part of the left thigh, below the inguinal region, and pains extended thence to the left hypochondrium. Afterwards the hardening and the pain decreased, and wholly disappeared after some months, so that the patient, in spite of the persisting slight enlargement of the left testis, felt absolutely healthy. In the course of a year, without apparent occasion, dysuria set in, associated with pains in the urethra and bladder. The urine itself exhibited no striking change. After the dysuria had lasted for some days the patient observed when making water the projection of a white thread-like body, which moved when touched. He recognized it as a worm, and attempted to extricate it by winding it round a bamboo rod. After he had drawn out about 18.5 cm. in this fashion the worm broke. The pain of urinating was temporarily relieved, but after a short period returned. The urine could only be expelled in drops by strong pressure, and with violent pains, which extended to the upper thigh. The urine was slightly cloudy, but on microscopic examination revealed nothing unusual except blood corpuscles. Whether further portions of the worm were expelled is not known, as the patient very soon returned from the hospital to the prison."—*Translation of Leuckart, 1886a, pp. 943–944.*

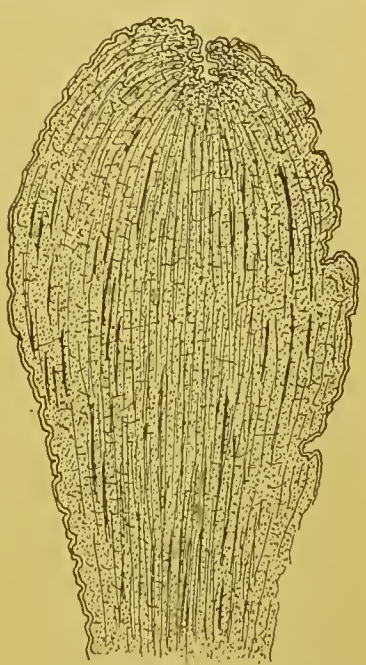


Fig. 36.—Longitudinal section of anterior end of fig. 34. X 10. After Ijima & Murata, 1888, pl. 5, fig. 6.

Ijima & Murata, in 1888, made an important contribution to this subject by publishing eight new cases of infection. Some of these had already been reported in Japanese. The clinical notes may be abstracted as follows:

Case III. Observed by Namba, a physician in the province of Echigo. "The patient was a boy, scrofulous and of weak bodily constitution. When three years old he suffered from frequent swelling of the scrotum on the right side, consequent on inguinal hernia. This complaint ceased, but after the lapse of several years, when he was 9 years of age, he began one day (July, 1886) to experience difficulty in urination, which had to be done often, but only drop by drop. Two days passed in this way, when, while making efforts for the passage of urine, a tapeworm-like body

came out of the urethra to the length of about 10 cm. On being drawn it contracted and tore off (to what length is not stated). On the following day the patient came to Mr. Namba, who put him in warm bath and carefully wound out the worm that still hung out of the urethral opening and showed signs of movement. The piece thus obtained measured over 20 cm. After this the urine passed unobstructedly, and an inquiry made many days afterwards showed that the boy had since felt in his usual health."—*Ijima & Murata, 1888, p. 150.*

Case IV. Reported at a Kyōto Medical Society meeting by S. Saitō. "The patient was a man (son of a farmer in Sayama Village, near Kyōto), 25 years of age and strong in body. Five years previously (1882) he is said to have suffered from violent gonorrhœa, at one period passing blood with urine. In half a year he recovered, but some time afterwards the desire for passing urine began to be frequent, sometimes as much as 15 or 16 times in a day. However, it was only by great efforts that he could discharge urine. Besides, he felt now and then itching or pressing sensations at the perineum. This state continued until October 14, 1887, when, while endeavoring for the passage of urine, a moving worm protruded itself from the urethra. Mr. Ogino, a physician of the village, carefully pulled it out until it tore off, leaving a part of the body behind. The piece obtained then measured 2 feet in length, about 6 mm. at the broadest and about 1.5 mm. at the narrowest part. For two days afterwards the patient felt pain in passing urine, which moreover contained blood. The frequent but scanty discharge of urine continued longer. When Saitō examined him, some time after, the urine was transparent and amber-colored, without precipitate or other abnormality. We do not know what has since become of the piece of the worm that was left in the urethra nor of the complaint in urination."—*Ijima & Murata, 1888, pp. 151–154.*

Case V. Observed by Mr. Toyoda in Kyōto. "The patient was a citizen of Osaka, 42 years old. On the morning of May 8, 1884, he began to discharge blood with urine, and in the afternoon a white worm appeared from the urethra while urinating. Toyoda was immediately called for. He succeeded in pulling out the entire worm. This measured about 364 mm. in length and about 12 mm. in breadth. Put in a vessel (with water?) it continued to contract and stretch and move about for nearly two hours. It was then put into glycerine for preservation. As the worm was new to Toyoda, he tried various means to identify it, but in vain."—*Ijima & Murata, 1888, p. 153.*

Case VI. Communicated to Ijima & Murata by R. Satō, of Utsunomiya. The patient was a young man, 17 years of age (1883), living at Kanazawa, in the province of Kaga. "The affected place was the region of the inner angle of the left eye. At this place not only the eyelids but also a part of the conjunctiva around the Plica semilunaris was in a state of severe inflammation. At a spot just over the Caruncula lachrymalis Satō observed a whitish spot which seemed to protrude itself. This was taken hold of by a pincette and pulled out, when it proved to be the worm in question."—*Ijima & Murata, 1888, p. 154.*

Case VII. Reported with Case IV at a Kyōto Medical Society meeting by S. Saitō. "The patient was a girl, 15 years old, living at or near Kyōto. On March 10, 1875, a vesicle-like protuberance formed itself, without any assignable cause, on the white of the left eye, midway between the cornea and the outer angle. Three days after, a physician, Mr. Shingū, examined and found it to be about of the size of the tip of little finger, soft and white, somewhat resembling cod ovary in appearance. In two hours he observed an elongated, macaroni-like body, which, on being slowly pulled out, was found to be a worm." Its length was 120 mm.; breadth, 3 to 6 mm.—*Ijima & Murata, 1888, p. 155.*

Case VIII. Under the care of Mr. S. Nagao, an army medical officer. "The patient was a native of Toyama, in the Province of Etchiu. In the summer of his fifteenth year of age that part of the right leg just above the knee joint on the inner

side swelled without any apparent reason for it. In the interior of the swelling a hard mass was to be felt. There was no pain. It was somehow treated by a local physician and disappeared in about ten days. A year after, the swelling reappeared at the same place, but again subsided in about the same length of time. From this time until his enlistment in the Nagoya garrison, the same swelling often recurred, invariably during the summer. The patient did not definitely remember if it took place every year or if there were years in which it did not occur. The enlistment was in May, 1885. In July of the same year the usual swelling appeared on the inner side of the lower one-third of the right thigh. It was observed that the swelling shifted its position up and down by itself to a small extent. It caused no trouble and soon disappeared. The next year passed without the appearance of the swelling. But in 1887, at the beginning of July, the swelling manifested itself this time at Scarpa's triangle. It did not at all interfere with the patient's general health, and dispersed in a few days. In September of the same year the swelling reappeared on the inner side of the middle of the thigh. As it gave him pinching pain, Mr. Nagao was consulted. The latter found a hard mass of the size of a fist, situated in the subdermal tissue at the above-mentioned spot. It could be shifted to a certain extent. The surrounding tissue was inflamed and swollen. Attempts were made to test if it contained anything obtainable by means of inserted syringe, but in vain. Iodine tincture was administered for about forty days. This had no desired effect; on the contrary, the swelling enlarged and the pain increased to such a degree as to make the patient incapable of performing his duties. He was then taken into the hospital. Carbolic-acid water was injected into the swollen tissue and cold wrapper applied. In five days there was indication of suppuration, and so a warm wrapper was substituted for the cold. In four days more the swelling suppurated and was cut open. Together with thin pus, the worm described below came out of the pus cavity. The latter, situated in the subcutaneous tissue, was traversed by trabeculæ of connective tissue in various directions. The wall of the cavity was at some places smooth, as if lined by serosa." * * *

"The removal of the worm, which was undoubtedly the cause of the almost annual swelling, took place just nine years after this occurred for the first time."—*Ijima & Murata, 1888, pp. 155–157.*

Case IX. Reported by Mr. K. Takahashi to Ijima & Murata. "The patient was a girl, 11 years old, native of Ko-aiki village, in the Province of Kōzuke. In spring of last year [1887] she suffered from conjunctivitis. From January of this year the upper eyelid of the left eye began to swell and redden, with intervals of comparative repose. Even during such an interval the eyelid seemed to be somewhat thicker than usual. On March 16, during a school exercise, she felt pain in the eye so that she was compelled to return home. However, the pain soon subsided, and the next morning she was able to attend school. On 19th, a swelling was noticed on the eye, which was investigated by Mr. Hagiwara, a physician in the town of Mayebashi. According to him, the swelling was of the size of a small bean, was situated on the eye bulb, beneath the conjunctiva, showed no signs of inflammation, and could be shifted to a certain extent. On cutting the conjunctiva open, a worm protruded itself. It was then drawn out by means of a pincette, during which process the patient felt a slight pain. It seems that the worm was originally situated in the region of the fornix of the upper eyelid, but had changed its position so as to come beneath the conjunctiva bulbi."—*Ijima & Murata, 1888, p. 161.*

Case X. Reported to Ijima & Murata by Takesaki. A worm was found by Dr. Disse in a subject in the dissecting room of their university. It was embedded in the subcutaneous connective tissue of the left inguinal region. "According to our informant, Mr. Takesaki, of the Pathological Institute, who was the eyewitness of the discovery, the worm was about one foot and a half long and tapeworm-like, but unsegmented. It was new to Disse, and Takesaki, who saw the specimens of Ijima and Murata, thought it to be the same worm."—*Ijima & Murata, 1888, p. 157.*

So far as we have learned, no new cases in man appear to have been reported since 1888, although the parasite has been mentioned in a number of medical and zoological works. According to several authors, Sonsino has reported the same worm from the jackal (*Canis aureus*). Sonsino's paper is not accessible to us. All other references found are based upon the observations of Manson, Cobbold, Leuckart, and Ijima & Murata, reviewed above. The Japanese papers we are unable to read, but the more important facts contained in them appear in the English paper by Ijima & Murata.

SPURIOUS PARASITISM DUE TO PARTIALLY DIGESTED BANANAS.

By Ch. Wardell Stiles, Ph. D.,
Pathologist of Bureau of Animal Industry,

and

Albert Hassall, M. R. C. V. S.,
Acting Assistant Zoologist of Bureau of Animal Industry.

[Figures 37–38.]

This laboratory receives numerous specimens of parasites which physicians in various parts of the country forward for determination. Not infrequently structures of various kinds are submitted to us as parasites which, in reality, are not of parasitic nature, but represent partially digested plant fibers of various kinds, and hair, clots, etc.

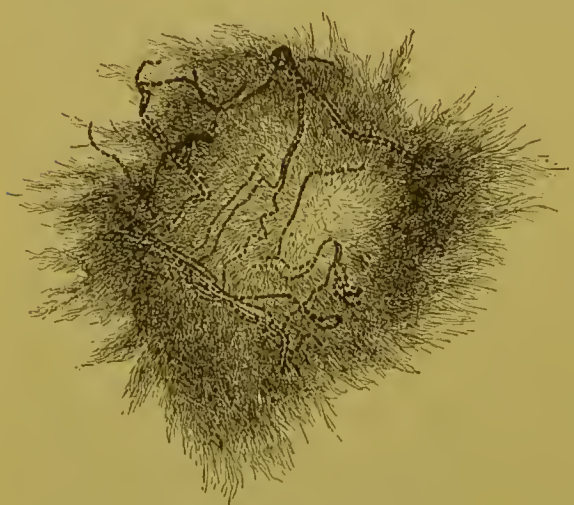


Fig. 37.—A portion of banana found in the stool. Enlarged. Original.

Quite recently two physicians have sent specimens which are identical with specimens received upon several former occasions. In former determinations of these particular objects we have contented ourselves by replying that the structures in question, which bear a superficial resemblance to minute tapeworms, were cells from some plant. In the last two cases received the objects were examined more closely, and they were determined to be tissues from a banana—a determination which has been confirmed by Dr. Erwin Smith and Mr. Albert F. Woods, of the Bureau of Plant Industry.

The objects in question, when submitted, represented dark-brown to black fibers, which looked as if they were segmented like a tapeworm,

and they were found attached to a pulpy yellowish mass. Each "segment" represented a plant cell which contained a dark mass. Our correspondent, in transmitting the last specimen, writes:

"I have mailed you this day a package containing two specimens, of which I desire to learn the origin and history. While they may be very common and you may recognize them immediately, they are so foreign to the medical profession that my efforts with the microscope have not aided me in accounting for them. They are in a 40 per cent solution of formalin.

"These organisms were both passed in the stool of a child not yet two years old. They were thoroughly mixed with the feces, and I am satisfied from my knowledge of the case that they were passed from the bowel. The child is one of two in a poor family, and this little one has been very low for the past three months, but has been for some two weeks improving considerably. The worm[a] was passed on Monday, the 21st instant [October, 1901], and was preceded for twenty-four hours by high temperature and fecal discharges containing pus. The smaller segmented organisms were passed since this, and are constantly in the stools at present, always attached to the small ovoid masses of colloid material.

FIG. 38.—Dark banana cells showing arrangement resembling tapeworm strobilae. Enlarged. Original.

"The child has not eaten any class of food from which this substance could be derived, because she has been helpless in bed for some six months. Her diet has been limited to milk and malted milk, toast and butter, grape and lemon juice, water, and medicines.

"I desire to learn, in so far as possible, the classification of these organisms, their life history and habits, that I may better account for their unusual source.

"The child has also been eating crushed banana, and in one other instance have I found foreign bodies similar to the segmented organisms."

[a] Determined by Dr. L. O. Howard as a lepidopterous larva, apparently *Pyralis farinalis*.

INDEX TO TECHNICAL NAMES.